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A CONTRIBUTION TOWARD A KNOWLEDGE OF THE LIFE HISTORY OF CULEX SOLLICITANS. PLATE 1.

BY JOHN B. SMITH, NEW BRUNSWICK, N. J.

The life history of a mosquito is ordinarily supposed to be rather a simple affair, and when egg, larva, pupa, and adult are known and the stage in which the winter is passed, it is assumed that little more remains to be learned. Yet of at least one species this is so little true, that our knowledge of the ordinary life cycle is a mere introduction to a real history of the species.

The species referred to is *Culex sollicitans* Wlk., which breeds abundantly along the shore districts in New Jersey, and which I have had under close observation during a portion of the season of 1901, and almost the entire season of 1902. Yet after carefully reviewing the results of the work done and the observations made, it appears that there is at least one full season's work yet required to clear up the questions left unsolved or raised by what has been already learned.

The salt-marsh mosquito is, from the economic standpoint, the most important species that occurs in New Jersey, and it is of New Jersey conditions that I intend to speak here. It dominates the entire southern half of the State and occurs in swarms where there is no chance of mosquito breeding for miles about, except in casual rain pools — and there the larva is never found. I do not mean to contradict observations made elsewhere, or to question conclusions drawn from such observations: I mean only to state actual facts and the deductions I make from them! It is quite possible that elsewhere, under other climatic conditions, these deductions may prove incorrect; but it will need equally extensive observations to demonstrate this.

The species passes the winter in the egg stage. This is demonstrated negatively by a failure to find adults at any time during the winter in quarters where the species is dominant, and where other species of CULEX and ANOPHELES may be found. Positively it is proved by the fact that very early in spring, swarms of minute larvae appear in winter-filled pools, as soon as the temperature reaches 50° Fahrenheit or over, and when not an adult can be found on the closest search.

Early in April (4) larvae pretty well grown were found in Cape May County in pools, high above ordinary or even summer storm tides, formed by the heaviest

winter storms and already drying down. These were found after a day of search for adults in which *Culex pungens* and (probably) *C. restuans* and *Anopheles punctipennis* were found; but no *C. sollicitans*. The same story was repeated on the 11th; and on the 19th and 20th, as the advance of the season cut off pools and ditches from tide connection, it was quite interesting to watch the appearance of the baby larvae in pool after pool and ditch after ditch.

A pool in which on the afternoon of the 18th there was no trace of larvae, about which not an adult could be stirred up, swarmed with minute larvae on the morning of the 19th. They had hatched during the night, from eggs that were already in the water and that required only the proper temperature to bring them out. This pool had been severed from the tide not over 48 hours and the resulting uniformity of temperature was sufficient to produce the proper condition for the larval life. At this time the temperature of the sea water in a creek at half tide was 50°. The temperature of the pools in which the young larvae appeared was 52°, and the older pools in which larvae were nearly full grown were at 54°, all Fahrenheit.

A very suggestive condition of affairs was found in a low meadow well above tide level, which had become filled with snow and rain and by drainage and formed a shallow pond about 1½ acres in area. I know positively that this area was dry except in one low corner during the entire season of 1901 between May 1st and September 15th, and I am informed and believe that it remained dry until late December. At all times during the summer the meadow swarmed with *C. sollicitans* and now, April 18, 1902, this entire area was inhabited by larvae of that species already nearly full grown; some, indeed, in the more shallow areas were already in the pupal stage. Obviously the eggs must have been laid in the dry meadow during the summer, for at no time when mosquitoes were flying was there any water to lay them into.

A large number of adults was bred from larvae gathered from pools of all kinds, ranging from fresh to very salt water and, except in one instance, only *C. sollicitans* was bred. The exception was a single lot of larvae from a pool of brackish water from which *C. cantans* was also obtained.

The larva of *C. sollicitans* is light slate gray in color, the head yellow, without markings of any kind, anal siphon short and stout, antenna short, slender, black at the tip, without obvious set off or prominent tufting. The figure (pl. 1, fig. 1) shows very fairly the appearance of the larva; the shape of the head and especially of the vertex being quite characteristic. Several other larvae resemble this and are not readily separable — notably those of *C. cantans* and *C. taeniorhynchus*.

What happened in Cape May County between April 20th and June 15th, when next I went there, I am unable to say; but the season had been very dry,

pools were everywhere much reduced, swarming with larvae and pupae, while the grass was filled with males. There were very few females and evidently, of the new brood just coming to maturity, only the males had yet emerged. A month later only a few bodies of water remained and they were drying up fast — so fast indeed, that thousands of larvae failed to come to maturity, and the half or quarter inch of water remaining in some pools was one squirming, wriggling mass.

A systematic search was now made for the eggs and they were found in quantity after the right places were determined. Of the older females, flying July 8–20, almost all contained eggs, ranging from soft, white, through pearly, translucent, as the shell formed, to black. Black eggs only were found in the meadows, well above the recent water line of such pools as yet remained, in the black mud in which their color made them almost invisible. It has been recently suggested that black is an unusual or exceptional color for mosquito eggs and that the habit of ovipositing on land rather than water is exceptional. This may be true for Louisiana where the observations leading to that suggestion were made; but in New Jersey *C. sollicitans* certainly lays black eggs in black mud. No other color would do so well under the circumstances and, outside the body of the mosquito, I never saw *C. sollicitans* eggs other than black! From a piece of sod about 4 inches square I washed the surface mud into a basin of water, waited until the whole settled to the bottom, to make certain that the eggs did not float, and next morning I had over 300 and possibly 500 lively young wrigglers.

It is important to note, in this connection, that though Mr. E. L. Dickerson (my assistant) and I collected several hundreds of specimens of mosquitoes between July 8th and 20th no examples of *C. taeniorhynchus* were seen, nor had I at any time previously in 1902 collected *C. taeniorhynchus* near this point. Neither was that species bred out of any larvae taken from the pools where we were then experimenting.

Two large sods were cut out of the marsh, well above any recent pools, and these were carried to New Brunswick to serve for laboratory tests. One sod was kept entirely dry, the other was kept constantly moist though never covered with water. The presence of eggs in both sods was demonstrated by actual examination and, at intervals, small pieces of sod were covered with water and the results were noted. From the dry sod larvae were always obtained in a short time — from one half to one hour; from the wet sod no larvae were obtained and all the eggs found were burst.

Two lots of larvae from the dry sod were bred to maturity and all the adults proved *C. taeniorhynchus!* The larvae were those of *C. sollicitans* except that they seemed undersized; but the adults were unquestionably the other species. Finally, September 21, two months after I took it up, I placed the remnants of the moist sod

in a large dish of water and next morning, to my great surprise, I found a fair lot of larvae. Out of these I obtained 8 adults and of these three were undoubted *C. sollicitans*.' It is a fair suggestion that there is something yet to be learned concerning the relationship between *C. sollicitans* and *C. taeniorhynchus*.

The season at the point where the collections were made was phenomenally dry and all pools and ditches remained dry until September 5 or 6, when a heavy storm filled everything. On the 11th, Mr. Dickerson investigated, found every pool swarming with recent larvae, and brought up 20 small sods from ten separate places well above the pool line and which had been entirely dry since early July and probably a month before that date. All but two of these sods had been tested and had shown the presence of eggs, hence it was a fair conclusion that eggs were generally distributed all over the meadow. From eight of these sods larvae were bred in the laboratory.

The eggs are spindle shaped just a little curved, shining, and when the larva hatches the upper ¼ lifts off as if by a hinge.

Another observation made at Beach Haven early in August throws further light upon the egg-laying habits of the species. A very heavy rain after a long dry spell, followed by a series of showers during which 3 or 4 inches of rain fell, filled every low area in the meadows with from ½ to 1½ inches of water. Within twenty-four hours this entire area was swarming with larvae just hatched and in forty-eight hours millions had perished because the water had disappeared: evaporated by the hot sun or soaked into the parched soil. It would be easy to add to this further observations, all tending to the point that the female oviposits almost anywhere in the meadows, at the base of grasses; but it would seem as if the above were sufficient.

I stated that, in early July, there was no trouble in finding gravid females and, indeed, almost all the females taken were full of eggs. It is a curious fact that this condition was not again duplicated later in the season.

From the beginning of September to the middle of October collections were made daily on the Newark meadows, and from that time to the end of mosquito flight in November, collections were made at least once and usually twice a week. Yet of the many hundreds of examples dissected not one contained mature eggs. After a long period of drought which left the upper part of the Newark meadows dry, *C. sollicitans* became very scarce in early September. On the night of the 4th and 5th there was a very heavy tide that flooded the meadows to the edge of the City, and covered the marsh tract at the mouth of the Elizabeth River. On the 6th Mr. H. H. Brehme, who made the meadows investigations for me, found everything swarming with recently developed larvae which grew rapidly as the pools gradually dried up. By the 16th almost the entire brood was mature and

the pools were crowded with pupae and a small proportion of full grown larvae. The grass was now full of adults which made life almost unbearable unless some method was used to keep them off. The practical disappearance of the earlier broods before the new brood issued fixed the age of these specimens and there was no other general brood that developed later on these meadows. I thought this a good opportunity to ascertain how long a time it would require for eggs to develop and hence had the collections made daily for some time. Yet at the end of the season I had no evidence that even one example out of the entire brood laid even a single egg! Lot after lot was received with absolutely undeveloped ovaries and not even a single example was found having eggs ready to be laid! The question is, did they lay any at all? In sods collected after the water had drained off none were found, and practically I do not know where the eggs are that will start *C. sollicitans* next spring. Dr. Dyar has suggested, in connection with another species, that of eggs laid in spring some might hatch during the summer but that others would lie over until the season following. It is, of course, possible that the same thing occurs in this case and that unhatched eggs are yet on the meadows, ready to develop under favorable conditions next spring. As to the number of eggs laid by a female, the dissections made gave an average of about 175. A very few reached 200 and very few had less than 150 unless the number was very small.

Another peculiarity of *C. sollicitans* in New Jersey is, its habit of travelling long distances inland, either by flight or by allowing itself to be carried by the prevailing winds. After the middle of July the entire pine region of South Jersey gradually fills up with these insects, sometimes swarming miles from any water and forty miles from any point where *C. sollicitans* larva has ever been found. On two occasions I made systematic search during two or three days, over a large area where *C. sollicitans* was the dominant species, finding larvae of forms whose adults escaped attention, but none of the shore species. Nor did I ever find in the pines even one adult example in which the ovaries were at all developed. August 15th, I captured 253 examples in one area in Ocean County, by sweeping so as to get old, inactive specimens, and not one of these had the ovaries in the least developed. A lot of 90 was captured a few days before by picking them from the coat of the collector and these were found in a similar undeveloped condition. I omitted to mention that in these flights, so far away from home, the males have no part — only the females wander. It is quite certain that none of the millions of these mosquitoes that infest the Jersey pines ever reproduce, because the surroundings are not suitable; and it is almost equally certain that they could not if they had the opportunity, because the ova simply do not develop.

The life period of the individual of this species is not determined; but it is

probably of considerable length, especially in those forms that do not reproduce. That they may bite more than once is certain, and direct experiment has proven that a full meal of blood may be so completely digested in one week, that scarcely a trace remains. The examination of a large number of specimens seems to indicate that blood food stimulates ovarian development, for in the great majority of cases where I found fully developed ova I found also blood remnants. In those cases in which such remnants were not found it cannot be safely concluded that such food had not been taken more than a week previously. But I did find numerous instances of ova starting development where the alimentary canal contained only a colorless liquid; probably plant juices.

Larvae of *C. sollicitans* were not found after November 4, but adults continued until well along in that month. In shelters along the Newark meadows where *C. nigritulus*, another salt water species, was found hibernating, not a *C. sollicitans* occurred in December.

Altogether the life cycle of this species offers points of interest that will require at least another full year to work out.

Plate 1.

Culex sollicitans Wlk.

1. Full-grown larva.
2. Pupa.
3. Adult male, from above.
4. Adult female, from side.
5. Head of larva from beneath.

CLASSIFICATION OF THE GALL-WASPS AND THE PARASITIC CYNIPOIDS, OR THE SUPERFAMILY CYNIPOIDEA. 1.

BY WILLIAM H. ASHMEAD, A. M., ASSISTANT CURATOR, U. S. NATIONAL MUSEUM.

In 1899, the writer separated the Hymenoptera into *ten* superfamilies, viz. — (1) Apoidea, (2) Sphecoidea, (3) Vespoidea, (4) Formicoidea, (5) Proctotrypoidea, (6) Cynipoidea, (7) Chalcidoidea, (8) Ichneumonoidea, (9) Siricoidea, and (10) Tenthredinoidea, and all of these have been classified down to genera, except the Formicoidea and the Cynipoidea.

During the year 1903, in a series of papers in PSYCHE, I propose to give my views on the classification of the Cynipoidea, a large, natural group falling in between the Proctotrypoidea and the Chalcidoidea, and still imperfectly known in this country, although well represented in genera and species.

An excellent *résumé* of the various schemes of classification proposed for these insects by Hartig, Giraud, Thomson, Förster, Walsh, and others is given by Cameron in his Monograph of the British phytophagous Hymenoptera, vol. 3, p. 152; also by Kieffer in his Monographie des cynipides d'Europe et d'Algérie, vol. 1, p. 51, so that I shall not repeat them here; they should be read by all interested in these wasps, as they show briefly the great progress made in the study and classification of these obscure insects, and how the *natural groups* have been gradually evolved, until to-day they are firmly established, whether they be called tribes, subfamilies, or families.

Most writers on these insects consider that they represent but a single family, the Cynipidae, with many subfamilies. In my opinion, however, there are at least *two* well-marked families, nearly as first pointed out by Hartig. One of these comprises all the parasitic species; the other, with the exception of a single group, the *Ibaliinae*, comprises the gall-makers and the gall-inhabiting species. The *Ibaliinae* are, however, a peculiar group and may yet be elevated to family rank.

The two families may be recognized by the use of the following table: —

TABLE OF FAMILIES.

Abdominal tergites meeting along the venter and entirely inclosing or concealing the sternites, at most with only a part of the hypopygium exposed.
Family LVIII. — Figitidae.

Abdominal tergites not meeting along the venter; all or nearly all the sternites visible. Family LIX. — Cynipidae.

Family LVIII. — Figitidae.

This family is a most extensive one and well represented in North America. The species are numerous and all, without a single exception, are parasitic. The majority attack principally the larvae of Diptera: a few, however, prey upon aphides and coccids; others attack the larvae of the lace-winged flies (Hemerobiidae); while others are said to prey upon beetle larvae.

Several well-marked natural minor groups may be recognized, as follows: —

Table of Subfamilies.

Abdomen ovate, compressed or subcompressed, often longly petiolate, the apex usually pointed 1

Abdomen short, globose or subglobose, the second segment the longest . 5

1. Scutellum not cupuliform, of ordinary shape or grooved, spined or cone-shaped, and usually foveate at base 2

Scutellum cupuliform, *i. e.*, with a cup-like elevation on its disc . . 4

2. Abdomen longly petiolated, the second segment usually somewhat *longer* than the third 3

Abdomen sessile or subsessile, or with a short petiole, the second segment *shorter* than the third.

Second abdominal segment *not* prolonged dorsally, as seen from the side, not tongue-shaped. . . . . Subfamily I. — Figitinae.

Second abdominal segment prolonged dorsally, as seen from the side, tongue-shaped. . . . . Subfamily II. — Onychiinae.

3. Petiole attached to the metathorax normally, between the hind coxae; fourth dorsal segment not longer than either the second or the third.

Subfamily III. — Anacharinae.

Petiole attached to the metathorax far above the hind coxae; fourth dorsal segment much longer than either the second or the third.

Subfamily IV. — Liopterinae.

4. Second abdominal segment always the longest, except in a single case, and usually occupying most of the surface of abdomen; hind tibiae with *two* apical spurs. . . . . Subfamily V. — Eucoilinae.

5. Scutellum rounded, smooth, convex; hind tibiae with only *one* apical spur.

Subfamily VI. — Xystinae = Allotriinae.[1]

[1] Allotria Westw. nec. Hübner 1816.

Subfamily I.— Figitinae.

1869. Figitoidae, Familie 7 (*partim*), Förster, Verh. d. zool. bot. gesell. Wien, bd. 19, pp. 329 & 363.

This subfamily is quite distinct from all the other subfamilies here recognized except the Onychiinae with which it agrees in all particulars except in the shape of the second dorsal abdominal segment, the second segment being normal and not produced dorsally, or tongue-shaped, as in the latter group.

The shape of the scutellum easily separates it from the Eucoilinae and the Xystinae (= Allotriinae), while from the Anacharinae and the Liopterinae it is distinguished by the non-petiolate abdomen.

Table of Genera.

1. Cheeks margined 2
   Cheeks immargined 15
2. Eyes bare, *not* hairy 3
   Eyes hairy or pubescent 6
3. Thorax opaque, very finely and thickly punctate, the parapsidal furrows complete 5
   Thorax smooth, polished, with distinct parapsidal furrows.
   Marginal cell closed 4
   Marginal cell open.
   Second abdominal segment bare at base; scutellum rugulose, bifoveate; ♀ antennae 13-jointed filiform, the third and fourth joints equal. . . . . Trischiza Förster
   (Type Figites agaricolarum Dahlb.)
4. Second abdominal segment pubescent basally, especially at the sides; scutellum rugose; areolet not close to the base of the marginal cell, ♀ antennae 13-jointed. Sarothrus Hartig
   (Type S. areolatus Hartig)
   Second abdominal segment bare at base; scutellum smooth; areolet close to the base of the marginal cell; ♀ antennae 13-jointed, ♂ 14-jointed, the third joint longer than the fourth. . . . . Melanips Haliday
   (Type Figites urticeti Dahlb.)
5. Marginal cell closed; ♀ antennae 13-jointed, ♂ 14-jointed, the third joint excised. . . . . Amblynotus Hartig
   (Type Scytodes granulatus Hartig)

6. Mesopleura *not* separated from the mesosternum by a sharp, longitudinal ridge or carina 7

Mesopleura separated from the mesosternum by a sharp, longitudinal ridge or carina 10

7. Scutellum rugulose, *without* an erect horn 8

Scutellum smooth, polished, *with* a small erect horn posteriorly . . 9

8. Second abdominal segment at base bare.

♀ antennae 13-jointed, submoniliform, the joints longer than wide.

Pycnotrichia Förster

(Type Figites urticarum Dahlb.)

Second abdominal segment at base bare.

♀ antennae 13-jointed, submoniliform, the middle joints not longer than wide. . . . . Homorus Förster

(Type Figites abnormis Giraud.)

9. Marginal cell closed; ♀ antennae 13-jointed. Thyreocera Ashmead

(Type Figites laeviscutum Prov.)

10. Marginal cell completely closed 11

Marginal cell more or less open along the fore margin . . . 14

11. Scutellum rugose, rounded or obtuse at apex, but never ending in a spine 12

Scutellum rugose, more or less carinate and ending in a long acute spine the spine sometimes channelled 13

12. Head and thorax coarsely rugose; ♀ antennae 13-jointed, filiform, the joints long, cylindrical, the third *shorter* than the fourth; abdomen compressed, the second segment as long as 3 and 4 united. . . . Kiefferia, gen. nov.[1]

(Type K. rugosa Ashm.)

Head and thorax smooth, shining; ♀ antennae 13-jointed, subclavate, the joints after the fifth oblong-oval, the third longer than the fourth, ♂ antennae 14-jointed, long, filiform; abdomen not much compressed.

Figites Latreille

(Type Cynips scutellaris Rosse.)

13. ♀ antennae 13-jointed, subclavate, ♂ antennae 14-jointed, filiform, the third joint a little shorter than the fourth . . . . Solenaspis Ashmead

(Type S. hyalinipennis Ashm.)

14. Scutellum rugose, more or less carinate and ending in a long acute spine, ♀ antennae 13-jointed, subclavate, ♂ antennae 14-jointed filiform.

Solenaspis Ashmead (partim)

Scutellum rugose, bounded by an elevated rim behind which is produced medi-

[1] Named in honor of Abbé J. J. Kieffer, Professor at Bitche, Deutsch-Lothringen.

ally into a short triangular tooth; ♀ antennae 13-jointed, subclavate, moniliform, ♂ antennae 14-jointed, the third joint slightly longer than the fourth or of an equal length . . . . . Figitodes Ashmead

(Type Figites quinquelineatus Say.)

15. Scutellum *without* a fovea at base; head and thorax opaque, finely punctate; ♀ antennae 13-jointed, subclavate, the last joint not especially large, ♂ antennae 14-jointed. . . . . Anolytus Förster

(Type Onychia biusta Hal.)

Scutellum *with* one large fovea at base; head and thorax smooth, shining; marginal cell small, closed; ♀ antennae 13-jointed, clavate, the last joint much enlarged, oblong, ♂ antennae 14-jointed. . Lonchidia Thomson

(Type Figites maculipennis Dahlb.)

Subfamily II.— Onychiinae.

1869. Onychioidae, Familie, 6 Förster, Verh. d. zool. bot. gesell. Wien, bd. 19, p. 329.

This group is separated from the Figitinae by the shape of the second dorsal abdominal segment which is produced dorsally or tongue-shaped; otherwise it is identical.

Table of Genera.

Scutellum *not* spined. 1

Scutellum ending in a spine 2

1. Mesonotum smooth, polished with two distinct furrows; scutellum smooth, not elevated, bifoveate at base; marginal cell open along the fore margin but not confluent with the costal cell; ♀ antennae 13-jointed, filiform.

Homalaspis Giraud

(Type Omalaspis novica Giraud.)

Mesonotum scabrous, opaque, with two distinct furrows and a median carina, scutellum large, elevated and truncate posteriorly with a channel throughout; marginal cell open at the base and along the fore margin, confluent with the costal cell; ♀ antennae 13-jointed, filiform. Onychia Haliday

(Type Callaspidia fonscolombei Dahlb.)

2. Marginal cell open along the fore margin and sometimes at base . . 3

Marginal cell completely closed 4

3. Mesothorax scabrous and carinate, with two parapsidal furrows; marginal cell open at base and along the fore margin, confluent with the costal cell; ♀ antennae 13-jointed, filiform. . . . . Aspicera Dahlborn
(Type Tenthredo scutellata Villers.)

Mesothorax smooth, shining, not carinate, with two parapsidal furrows; marginal cell closed at base; ♀ antennae 13-jointed, filiform. Belna Cameron
(Type B. nigriceps Cam.)

4. Mesonotum smooth, shining, with distinct parapsidal furrows; ♀ antennae 13-jointed, subclavate. . . . . Neralsia Cameron
(Type N. rufipes Cam.)

Subfamily III. — Anacharinae.

1869. Megapelmoidae, Familie, 5 Förster, Verh. d. zool. bot. gesell, Wien, bd. 19, p. 329.

This subfamily is easily recognized by the abdomen which is distinctly petiolated and attached normally to the metathorax, the fourth dorsal segment being not longer than either the second or the third.

Table of Genera.

Scutellum produced at apex into a long spine 1
Scutellum more or less conical, but never ending in a spine 2

1. Mesonotum rugose, *without* parapsidal furrows; marginal cell long and open along the fore margin; abdominal petiole at least as long as the hind coxae, smooth; ♀ antennae 13-jointed. . . . . Acanthaegilips Ashmead
(Type A. brasiliensis Ashm.)

Mesonotum smoother, with distinct parapsidal furrows, the middle lobe usually more or less rugulose posteriorly; marginal cell shorter and completely closed; abdominal petiole much shorter than the hind coxae . Xyalaspis Hartig.
(Type Cynips nitidula Dalman.)

2. Scutellum separated from the mesonotum by a suture or furrow and *with* two shallow oblique foveae at base 3

Scutellum not separated from the mesonotum by a furrow and *without* foveae at base 4

3. Abdominal petiole shorter than the hind coxae, striate or rugose; middle segment areolated. . . . . Aegilips Haliday
(Type Anacharis rufipes Westw.)

Abdominal petiole usually longer than the hind coxae and smooth; median segment not areolated. . . . . Anachares Dalman
(Type Cyaiips eucharoides Dalm.)

4. Mesonotum *with* distinct parapsidal furrows. . Acothyreus Ashmead [1]
(Type A. oceola Ashm.)

Mesonotum smooth, *without* parapsidal furrows. . . Synapsis Förster
(Type S. agrisgranensis Först.)

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XXXIX.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Therina fiscellaria Guen. The larva has been much confused. It is apparently this one referred to by Packard as *T. fervidaria* in Mon. Geom., p. 494, Rept. U. S. dept. agric., 1886, p. 329, and 5th Rept. U. S. ent. comm., p. 186. In the latter publication the description of *T. endropiaria* on p. 187 is of this species, Riley's specimen being before me. I have referred to these descriptions previously (PSYCHE, vol. 9, 11, 1900), but have made there an error in regard to the food plant of *T. fervidaria* (lines 6 to 8, second column); it is really spruce as Packard gives it. The life history of *T. fiscellaria*, here given, was obtained from moths kindly sent by Mr. H. S. Williams of Rockledge, Florida, in May. The first larvae were matured in August and the moths appeared again in September.

EGG. Elliptical, the narrow diameter only slightly flattened in a small area on the middle of the side; truncation forming a decided rim, but elevated centrally; depressed end rounded, almost like the other end. Surface smooth, except for very fine, roundedly hexagonal, moderately distinct reticulations, all over it, becoming a little larger at the antemicropylar end. The minute pores at the angles show whitish in the shadow. Olivaceous green, shining, turning dull reddish. Size .9 × .6 × .5 mm. Hatched in two weeks.

STAGE I. Head rounded bilobed, erect, free, rather large, mouth pointed; dull dark brown, darker in the sutures, lighter on the faces of the lobes, eyes black; width .3 mm. Body cylindrical, normal, moderately elongated, feet normal slender, the abdominal ones rather long; segments slightly enlarged centrally. Grayish white, a shaded dark gray broad dorsal band, narrowed in the incisures and absent at the ends. A subgeminate, darker, narrower and more distinct subdorsal band, fainter at the ends but continuous, narrowed and confluent in the incisures. A similar subventral band, geminate, but segmentarily, macu-

[1] In all cases I retain the original spelling of genera, Eucoila, not *Eucocla*, Acothyreus not *Acantothyreus* etc.

lately joined. A series of large, segmentary, ventral, clouded spots on the legless segments. Feet all pale; no shields; setae short, stiff, white; tubercles imperceptible. Segments obscurely, rather numerously annulate.

STAGE II. Head rounded, lobes large, full, but not bulging before, a little wider than high; white, a faint gray shade over vertex; tubercles dark as also sutures of clypeus and ocelli; width .5 mm. Body moderate, normal, whitish with a bark gray tint; dorsal space broadly pale, containing black tubercles i and ii, bordered by a double black lateral band broken into dashes. A more continuous and grayer subventral band. Feet and venter pale, tubercles dark, setae short, pale. Segments finely, faintly annulate. No shields. The marks get fainter with growth, the general appearance being light, whitish gray.

STAGE III. Head rounded bilobed, moderate, white, very faintly grayish reticulate, small black dots on tubercles and at apex of clypeus; width .9 mm. Body segments finely irregularly annulate, grayish white, the dorsal line more translucent; black dots on tubercles i and traces of the former lines as rather remote dots and streaks laterally and suprastigmatally, not forming well traceable lines. Subdorsal and subventral bands rather whiter than the general color. Feet all pale; setae obscure; tubercles black marked.

STAGE IV. Head the same, the face a little more black dotted, quite thickly so in the vertical suture; width 1.3 mm. Sides of body faintly grayish between the broken black lines, indicating a broad lateral shade. Dorsal space white, centered with a luteous line. Tubercles black.

STAGE V. Head rounded, low bilobed, thick; white, luteous freckled, blackish in incisure with distinct black dots on the tubercles; ocelli black; width 1.9 mm. Body rather slender, moderately elongate; nearly white, the ground color pale luteous with straight white subdorsal line and wavy irregular one in dorsal space, narrowly and obscurely black edged; a waved suprastigmatal line, black edged; an irregular white band on subventral fold not distinctly edged and a broad subventral band, straight like the subdorsal, black and brown edged. Tubercles small black; feet pale; spiracles black; general appearance very light bark gray, the lines not contrasted with the ground color.

STAGE VI. Head rounded, bilobed, narrowed a little above, lobes full before. Fleshy white, faintly mottled with light brownish; tubercles marked by distinct round black dots; width 2.3 mm. Body normal, moderate, smooth, a scarcely indicated dorsal elevation on joint 12. Ground color pale brown, dorsal tubercles marked by small black dots. Dorsal space reddish brown, containing an addorsal irregular white line, all edged by six crinkled brown lines; a broad fleshy white subdorsal line, sometimes partly orange filled; lateral space whitish, partly brown and black filled, containing a lateral irregular whitish line, all edged by four crinkled black lines, more or less incised and broken; a broad white substigmatal band; subventral space brown, edged by two crinkled brown lines; a white subventral band; pedal space whitish, edged by brown lines; a white ventral band containing segmentary gray spots. Feet pale, brown bordered and black dotted; spiracles black; no shields; setae small, dark.

Pupa in a slight cocoon of leaves and coarse silk, whitish, spotted and streaked as described by Packard.

The larvae fed on several species of oak.

INSECT PSYCHOLOGY.

BY JUSTUS WATSON FOLSOM, CHAMPAIGN, ILL.

This article is intended to summarize, without much argument, some of the best approved views of the present upon this difficult subject.

Insects are eminently instinctive; though their automatic behavior is often so remarkably successful as to appear rational, instead of purely instinctive.

Instinct, as distinguished from reason, attains adaptive ends without prevision and without experience. For example, a butterfly selects a particular species of plant upon which to lay her eggs. Caterpillars of the same species construct the same kind of nest, though so isolated from one another as to exclude the possibility of imitation. Every caterpillar that pupates accomplishes the intricate process after the manner of its kind, without the aid of experience.

Instinctive actions all belong to the reflex type,— they consist of coördinated reflex acts. A complex instinctive action is a chain, each link of which is a simple reflex act. In fact, no sharp line can be drawn between reflexive and instinctive actions.

Reflex acts, the elements from which instinctive actions are compounded, are the inevitable responses of particular organs to appropriate stimuli, and involve no volition. The presence of an organ normally implies the ability to use it. The newly born butterfly needs no practice preliminary to flight. The process of stinging is entirely reflex; a decapitated bee retains the power to sting, directing its weapon toward any part of the body that is irritated, and a freshly emerged bee, without any practice, performs the stinging movements with the greatest precision.

As Whitman observes, the roots of instincts are to be sought in the constitutional activities of protoplasm.

The ostensible rationality of behavior among insects, as was said, often leads one to attribute intelligence to them, even when there is no evidence of its existence. As an illustration, many plant-eating beetles, when disturbed, habitually drop to the ground and may escape detection by remaining immovable. We cannot, however, believe that these insects "feign death" with any consciousness of the benefit thus to be derived. This act, widespread among animals in general, is instinctive, or reflex, as Whitman maintains, being, at the same time, one of the simplest, most advantageous and deeply seated of all instinctive performances.

Take the many cases where an insect lays her eggs upon only one species of plant. The philenor butterfly hunts out Aristolochia, which she cannot taste, in order to serve larvae, of whose existence she can have no fore knowledge. Ovipo-

sition is here an instinctive act, not performed until it is evoked by some sort of stimulus — perhaps an olfactory one — from a particular kind of plant.

Some determinate sensory stimulus is, indeed, the necessary incentive to any reflex act. The first movements of a larva within the egg-shell are doubtless due to a sensation, probably one of temperature. Simple contact with the egg-shell is probably sufficient to stimulate the jaws to work, and the caterpillar eats its way out; yet it cannot foresee that its biting is to result in its liberation. Nor, later on, when voraciously devouring leaves, can the caterpillar be supposed to know that it is storing up a reserve supply of food for the distant period of pupation and the subsequent imaginal stage. The ends of these reflex actions are proximate and not ultimate, except from the standpoint of higher intelligence.

An action can be regarded as purely instinctive in its initial performance only, because every subsequent performance may have been modified by experience; in other words, habits may have been forming and fixing, so that the results of instinct become blended with those of experience. Thus the first flight of a dragon-fly is instinctive and erratic, but later efforts, aided by experience, are well under control.

When once shaped by experience, reflex or instinctive actions tend to become intense habits. Thus, certain caterpillars, having eaten all the available leaves of a special kind, will almost invariably die rather than adopt a new food plant, whereas larvae of the same species will eat a strange plant if it is offered to them at birth. An act is strengthened in each repetition by the influence of habit, to the increasing exclusion of other possible modes of action. Many a caterpillar, having eaten its way out of the egg-shell, does not stop eating, but consumes the remainder of the shell,— a reflex act, started by a stimulus of contact against the jaws and continued until the cessation of the stimulus, unless some stronger stimulus should intervene. It has been said that the larva eats the remains of the shell because they might betray its presence to its enemies. Whether this is true or not, to assume conscious foresight of such a result on the part of an inexperienced caterpillar is worse than unnecessary.

With insects, as with other animals, many instincts are transitory; even when partially fixed by habit, they are replaceable by stronger instincts. Thus the gregarious habit of larvae is finally overpowered by a propensity to wander, which does not mature, however, until the approach of the transformation period. The reproductive instinct is another of those impulses that do not ripen until a certain age in the individual.

Broadly speaking, instinctive actions lack individuality,— are performed in the same way by every individual of the species. The solitary wasps of the same species are remarkably consistent in architecture, in the selection of a special kind of prey, the way in which they sting it, carry it to the nest and dispose of it; all these

operations, moreover, are performed in a sequence that is characteristic of the species. Examples of this so-called inflexibility of instinct are so omnipresent that insect behavior as a whole is admitted to be instinctive, or automatic. Insects are capable of an immense number of reflex impulses, ready to act singly or in intricate correlation, upon the requisite stimuli from the environment.

To normal conditions of the environment, the behavior of an insect is accurately adjusted; in the face of abnormal circumstances, however, demanding the exercise of judgment, most insects are helpless. The specialization to one kind of food, though usually advantageous, is fatal if the supply becomes insufficient and the larva is unable to adopt another food. A species of SPHEX habitually drags its grasshopper victim by one antenna. Fabre cut off both antennae and then found that the SPHEX, after vain efforts to secure its customary hold, abandoned the prey. Under such unaccustomed conditions, insects often show a surprising stupidity, capable as they are amid ordinary circumstances.

Notwithstanding such examples, the common assertion that instincts are "blind," or inflexible, is incorrect. Instinctive acts are not mechanically invariable, though their variations are so inconspicuous as frequently to escape casual observation. A precise observer may detect individual variations in the performance of any instinctive act, — variations which are analogous to those of structure.

To take extreme examples, the Peckhams found that an occasional queen of *Polistes fusca* would occupy a comb of the previous year, in place of building a new one. They observed also that one AMMOPHILA, in order to pound down the earth over her nest, actually used a stone, held between the mandibles.

While most of the variations that one encounters are small and, in a sense, accidental, or purposeless, such novel departures as those of the POLISTES or the AMMOPHILA denote adaptability.

Even the despotic power of habit may be overborne by individual adaptability. Among caterpillars that have exhausted their customary food, there are often a few that will adopt a new food-plant and survive, leaving their more conservative fellows to starve.

As Darwin himself held, the doctrine of natural selection is applicable to instincts as well as to structures. All reflex acts are to some extent variable. Disadvantageous reflexes or combinations of reflexes eliminate themselves, while advantageous ones persist and accumulate.

Indeed, structures and instincts must frequently have evolved hand in hand. The remarkable protective resemblance of the KALLIMA butterfly would be useless, did not the insect instinctively rest among dead leaves of the appropriate kind.

Though manifestly dominant, instinct alone fails to account for all insect behavior. The ability of an insect to profit by experience indicates some degree of intelligence.

If we take, as one criterion of intelligence, the power to choose between alternatives, then insects are more intelligent than is generally admitted. The control of locomotion, the selection of prey, and the avoidance of enemies, as results of experience, indicate powers of discrimination. Honey bees sometimes utilize varnish, pitch, and other substances as cements, instead of laboriously manufacturing their propolis from the exudations of plants.

Again, an ant, having discovered food, returns and leads its companions to the prize; or one ant may summon others to its assistance. Here the power of intercommunication, conceded to exist among the social Hymenoptera, implies some amount of intelligence.

If instinct is blind, or mechanical, with no adjustment of means to ends, then a pronounced individuality of action must signify something more than instinct, — as in the case of the AMMOPHILA.

From the standpoint of pure instinct, indeed, much of the behavior of the social Hymenoptera is inexplicable. The activities of the harvesting ants, the military or the slave-holding species, are of such nature that the possibility of education by experience and instruction is strong, to say the least. In fact, Forel and others maintain that a young ant is actually trained to its domestic duties by its older companions and that the well-known discrimination between friends and foes is also a matter of education.

However intelligent the social Hymenoptera may be in their way, they show no signs of the power of abstract reasoning. Even ants, according to the experiments of Lubbock, display profound stupidity in the face of novel emergencies when they might extricate themselves by abstract reasoning of the simplest kind. The thoughts of an ant or a bee seem to be limited to simple associations of concrete things.

There are two leading theories as to the origin of instinct. Lamarck, Romanes, and their followers have regarded instinct as inherited habit; have supposed that instincts have originated by the relegation to the reflex type of actions that at first were rational, and that instincts represent the accumulated results of ancestral experience. This *habit* theory, however, has little to support it, and assumes the inheritance of acquired characters — which has not been proved.

The *selection* theory of Darwin, Weismann, Morgan, and others has much in its favor. It regards reflex acts as primitive, as the raw material from which natural selection, as the chief factor, has effected those combinations that are termed instincts.

Finally, there is a growing tendency to regard instinct as the basis of intelligence. With the advent of consciousness, involving memory and choice, instinct ceases to be blind and reason begins.

SOME SPECIES OF EULECANIUM (COCCIDAE) FROM FRANCE.

BY T. D. A. COCKERELL, EAST LAS VEGAS, N. MEX.

Dr. P. Marchal has sent me five species of EULECANIUM collected in France. It might be supposed that these insects, coming from such a country, would be easily referred to well-known species; but as a matter of fact their identification has given me much trouble. Judging them by the standards of specific distinction laid down by Signoret, they could all be regarded as new to science. However, it is now generally admitted that Signoret over-divided his species, and an extreme view in the opposite direction is held by Mr. R. Newstead, who writes me that in his opinion *Lecanium capreae*, *genevense*, and *fuscum* (at least as understood in England) are one species; and further, that *L. persicae*, *rosarum*, and *sarothamni* are also one. This surprising union of species hitherto regarded as distinct must be taken seriously, for Mr. Newstead has gone over the ground very carefully, and would not make such a statement without excellent reasons. It was otherwise when Förster proposed to unite the whole series of EULECANIUM under the specific name *vagabundum*.

The measurements of antennae and legs in this paper are all in micromillimeters. The paper is based wholly on females. The tarsus is always measured without the claw.

EULECANIUM MAGNOLIARUM Ckll. var. HORTENSIAE, *var. nov.*

On HORTENSIA (*i. e.* HYDRANGEA); Nice, July, 1899. (Marchal No. 7.)

Rather light ferruginous, elongated, with a strong and sharp dorsal keel (in dried examples); surface rugose and tuberculate. The scales appear to have been variegated with black and yellow when alive.

Scales crowded, overlapping; long. 5½, lat. 3, alt. about 1½ mm.

Legs: femur and trochanter, 180; tibia, 120; tarsus, 93. Legs not as described for *L. berberidis*. [1]

Antennae 8-jointed, 3 and 4 very variable; three antennae measured thus:

Joints:	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)
	45.	52.	45.	75.	45.	33.	30.	42.
	?	45.	60.	66.	42.	27.	24.	35.
	?	42.	65.	57.	48.	27.	27.	45.

[1] Externally, the *Lecanium berberidis* of Berlese and Leonardi (Cherm. Ital.) is very like *E. hortensiae*, having the same shape, same keel, and pustulated surface. It differs from *E. hortensiae* in being larger, much redder, and without the black or blackish marbling. I doubt its identity with the true *L. berberidis*.

The typical *E. magnoliarum* was found in California under circumstances indicating that it was imported from Japan. No doubt *E. hortensiae* reached France from the Orient, and it is not native anywhere in Europe. Of the native French species, the nearest to it is *Eulecanium genistae* (Signoret).

These forms are placed in EULECANIUM, but they show a good deal of resemblance to CALYMNATUS

EULECANIUM CILIATUM Douglas, *var. a.*

Marchal No. 12. Collected in France in 1900 (exact locality not stated).

Rather large, moderately convex, dark ferruginous, with a prominent but very broad and blunt longitudinal keel; sides deeply and coarsely pitted.

Two scales measure thus: — long. 6½, lat. 5, alt. 3 mm.
long. 5, lat. 4, alt. 2⅔ mm.

Anterior leg: femur + trochanter, 162; tibia, 114; tarsus, 78.

Antennae 6-jointed; joints: (1.) 36, (2.) 30, (3.) 98, (4.) 21, (5.) 18, (6.) 36.

This species is new to France; it was sent as doubtful *E. robiniarum*, which it evidently is not. In the structure of the scale, with the prominent long smooth dorsal area, limited on either side by pits, *E. ciliatum* exactly resembles the American *E. canadense* and *kansasense*, which are well figured by Hunter in Kansas univ. quarterly, April, 1899, Pl. xiv.

The antennae of the present insect (but not the scale) agree with *E. websteri*, *kingii*, and *armeniacum*, and nearly with *tarsale*. The antennae also resemble quite closely those of *E. rosae* (but joint 2 is too short), *prunastri*, and *kansasense* (but joint 3 is too long).

EULECANIUM GENEVENSE var. MARCHALI, *var. nov.*

On ROSA; Fontenay (Seine); Marchal No. 3.

Light ferruginous; easily known from *E. rufulum* by its somewhat larger size, more shining surface, and deeply pitted sides. There is no distinct longitudinal keel. Long. 4½, lat. 3⅔, alt. 3 mm. After boiling in liquor potassae the skin becomes nearly clear, but the area around the anal lobes remains brown. The antennae are 7- to 8-jointed (one specimen has the left antenna with 7, and the right with 8 joints), short and rather stout, without the long bristles of *E. rubi*. The tessellation of the skin is very distinct in places.

Anterior leg: femur + trochanter, 150; tibia, 90; tarsus, 78.

Measurements of three antennae:

Joints:	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)
	15 (prox.)	21.	72.	27.	25.	18.	23.	—
	?	27.	84.	27.	27.	21.	28.	—
	?	24.	42.	36.	33.	30.	24.	30.

This is near to *E. genevense*, and is provisionally regarded as a variety of it, but *genevense*, and also the forms said by Mr. Newstead to be identical with it, are always described as having 6-jointed antennae.

The 7-jointed antenna is of the general type of *E. maclurarum*, but the third joint is much too short. The 8-jointed antenna is not unlike the *E. rosarum* of King and Reh, which I feel persuaded is not the true *E. rosarum*. The 7-jointed antenna is not at all like the 7-jointed form of the King and Reh *E. rosarum*.

EULECANIUM ALNI var. RUFULUM, *var. nov.*

Dr. Marchal sent two lots, one on CARPINUS, La Vienne, France, July 25, 1896; the other marked "*Lecanium quercus*, Department de la Vienne, France," June 6, 1896.

Rather small, light ferruginous, convex, not shiny; not keeled, nor punctured. Long. 3½–4, lat. 2⅘–3, alt. 1⅘–2 mm.

Legs: femur + trochanter, 126–135; tibia, 84–96; tarsus, 60–69. The legs and antennae are very slender; width of femur, 30–33; width of tibia, 12–15.

Antennae 7-jointed, varying to 6 and 8. Measurements of four antennae:

Joints:	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)
	?	30.	75.	21.	21.	54.	—	—
	30.	33.	90.	24.	21.	78.	—	—
	?	30.	93.	18.	24.	18.	30.	—
	?	27.	75.	21.	18.	18.	15.	24.

It will be observed that the third joint always remains very long, even in the 8-jointed forms. The 8-jointed antennae are near those of *E. rugosum*, but the scale is different.

I have not seen the typical *E. alni* Modeer (*Lecanium alni* Douglas, Ent. mo. mag., Sept. 1886, p. 80-81), nor did Signoret recognize it. Douglas found it at Lewisham and Catford, England, on alder. The proposal to treat *E. rufulum* as a variety of *E. alni* is provisional, and depends upon a strong similarity which seems to be indicated by Modeer's original (1778) description.

EULECANIUM PRUNASTRI Fonsc., *var. a.*

Marchal No. 14, on peach, at Cette, June, 1898.

Small and very dark, almost black, very convex, no longitudinal keel, sides more or less malleate. Three examples measure:

Long. 3½, lat. 3½, alt. 2½ mm.
" 3⅗, " 3½, " 2½ "
" 2½, " 3 " 1⅘ "

The scale is unusually dark and strongly chitinized. There is a punctured band running anteriorly from the anal plates in the middle line.

Antennae 8-jointed. Below I give measurements of the antennae of the present insect, and also of 6- and 7-jointed *E. prunastri*, from slides prepared by Mr. Pergande.

Joints:	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7)	(8.)
	?	33.	42.	24.	36.	21.	18.	33.
	?	45.	45.	60.	17.	21.	34.	—
	?	30.	90.	17.	21.	34.	—	—

BUTTON-BUSH INSECTS.

BY JAMES G. NEEDHAM, LAKE FOREST, ILL.

Entomologists who collect from flowers know how many insects gather about the heads of the button-bush — the "honeyballs" of popular nomenclature. These heads are conspicuously white, their fragrance is very marked, their nectar is abundant, often filling the corollas so full that short-tongued insects may sip from them, and the protandrous stamens heap their pollen upon the style knob, which then protrudes conveniently for the benefit of pollen feeders. By carefully watching these flowers through their season, one may obtain nearly all the flower-visiting insects of his neighborhood.

My own too brief season of butterfly collecting was spent at Piasa Bluffs on the Mississippi, where there were a few button-bush clumps along the river banks under the edge of the bluffs; and there the butterflies swarmed — all the butterflies of that vicinity. They made a picture there which I shall always remember with delight. Dozens of them in a bright hued throng, poising on the swaying heads, or hovering over the dark green clumps that were set at the outer edge of a thin fringe of vegetation that stretched between the gray cliffs above the shining river below.

The predominant visitors are butterflies, but this predominance is unduly apparent because these are so conspicuous. Robertson (Bot. gaz., vol. 16, 65–66) lists 60 species of insects as visitors to the button-bush flowers. Of these 26 are butterflies and 20 are bees.

I spent the summer of 1899 in Lake Forest; and there, under favorable conditions, began a study of the insects affecting the button-bush — not the transient visitors of the flowering season, but the resident insects that enter more closely into ecological relations with it. I found some 30 species of these, and made some observations on the habits of many of them. I planned to continue my observa-

tions, but other matters came into my hands demanding all my time, and no further opportunity being now in prospect, I have concluded to publish such facts as are already gathered.

I studied the button-bush in a shallow open pond on the country place of Mr. R. M. Bissell, within easy walking distance of my home, and in a "pot-hole" in the woods near by. The pot-hole was filled almost exclusively with a dense and tall growth of these shrubs. In the pond the clumps were scattered, low and broad in form, and were restricted to the borders of a flat island that lay in the midst of it. This pond is of several acres extent, and is hardly too deep for wading with hip boots anywhere. But it is being filled, by the land building of the button-bush around the borders of the island, and by that of the tussock sedges that fringe all its outer borders. Each summer it is reduced by evaporation to a few little pools, at which time the button-bush clumps stand upon a black soil that is fissured with deep sun-cracks. On the island, clumps of glaucous willow and red dogwood crowd the button-bush clumps in the rear, and they are generally flanked by some or all of the following weaker plants: *Calamagrostis canadensis*, *Panicularia fluitans*, *Carex utriculata*, *Dulichium spathaceum*, *Sparganium eurycarpum*. *Sagittaria variabilis*.

The clumps here are impenetrable thickets. Muskrats build their huge hummocks under them, immensely furthering the land-building process; tree frogs climb the gray trunks, and red wing blackbirds build their nests in the tangled branches. The density of their growth excludes other large plants, but an interesting group of weaklings nestle in their shadows: *Viola blanda*, *Scutellaria galericulata*, *Galium trifidum*, and *Onoclea sensibilis*. At the surface of the water the trunks are closely enwrapped by a moss of the genus *Amblystegium*.

The button-bush is our only woody representative of the madder family. Coffee is akin to it, and most of its relatives are tropical shrubs. It is not well adapted in some respects to our latitude. It develops only unprotected buds, that are killed each winter together with the terminal shoots, the new growth from adventitious buds in spring being late in appearing. One result of this, with a bearing on the insect life found associated with it, is that the shoots of one season are lateral to those of the preceding season, and the growth is scragged, and there are many dead tops, broken ends, and exposed pith cavities.

Very few insects have been recorded from the button-bush hitherto, aside from the flower visitors. Dr. Packard in the 5th report of the U. S. entomological commission mentions three, two of these notes being citations of earlier records by Harris and Riley. These are: —

1. Platysamia cecropia (Linné), p. 402.
2. Callosamia promethea (Drury), p. 525.
3. Hyphantria cunea (Drury), p. 249.

These are all general feeders on foliage of woody plants. An undetermined tineid from *Cephalanthus* is mentioned in Insect life, vol. 3, p. 18. These and Robertson's list of visitors to the flowers, are the only records I have found. When beginning my study I wrote Dr. L. O. Howard, asking him whether the records of the Division of entomology of the Department of agriculture included other species, and he kindly sent me the following list: —

1. Harrisimemna trisignata (Walk.).
2. Laverna cephalanthiella Chamb.
3. Aphis cephalanthi Thomas.
4. An undetermined cecidomyiid.

In my own studies I have come upon only the first of Dr. Packard's list and the third of Dr. Howard's. I will now give my own list, omitting all flower visitors except such as are not included in Robertson's list, arranging them by orders first with notes and observations, and concluding with a summary list according to habits.

LEPIDOPTERA. 1. *Melanomma auricinctarium* Grote. Pupae of this species may be found singly in pith cavities excavated in the broken ends of dead stems about half an inch in diameter, during the entire winter and early spring. They are found also in cavities excavated in the bark of the thickest of the fallen stems, generally a number near together, where conditions are favorable. The cavities in the bark are short and tortuous, and are directed toward the surface at the end and cut almost, but not quite through, by the larvae before pupating. The pith cavities in standing stems have the appearance of excavations of the wasp DAHLBOHMIA, (No. 7 *post*). Although this is perhaps the most abundant of the Lepidoptera found on the button-bush, larvae were not observed. A good many heads of fruit were found still hanging in winter, with holes bored through them transversely to the seeds; I did not find the borers. I thought they might perhaps be the larvae of this species, but found no proof. From pupae collected for breeding, imagos emerged in May. They were determined by Prof. C. H. Fernald.

2. *Acronycta oblinita* (Smith & Abbot). This is a common leaf feeder. Its larvae when newly hatched are ramblers, feeding here a little and there a little, but when they are older they feed at the tips of the flowering shoots. They begin at the top, eating the leaves off down to stubs of the petiole, thus consuming generally two, sometimes three or four pairs of the opposite leaves, and then removing to another shoot. When not feeding they are often to be found resting in seclusion on the gray bark of the preceding year's growth. They are very frequently parasitized, especially by the big red *Rhogas rileyi* (No. 8 *post*); and the parasitized individuals settle upon the stems, first overspreading them with a thick mat of silk, attach their feet, and then at their death there exudes in the thoracic region a

brownish fluid which hardens and glues the old skin to the silk. RHOGAS emerges through a big round hole cut in the back of the larva, but the empty larval skin may hang through several seasons, until bleached and weathered and bare. I have found a number of them in early spring still attached, and well preserved.

I bred many parasites from the larvae of this species, but only one moth; that one emerged on the 20th of July from a cocoon that was spun by the larva in the top of a SCIRPUS stem, within a nest made of deflexed bracts and flowering branches fastened with silk to the side of the stem. That specimen and specimens of the three next following species have been determined by Prof. John B. Smith.

3. *Eudryas grata* (Fabr.). A single pupa of this species was found in spring under the bark of a fallen button-bush stem, in a well-formed pupal cell, and was bred indoors, the handsome moth emerging in May.

4. *Agrotis ypsilon* Rott. } A number of moths of these two species were
5. *Plusia simplex* Guen. } seen visiting the button-bush flowers for nectar at dusk.

6. *Platysamia cecropia* (Linné). A single egg cluster of this species was found on a button-bush leaf, and the larvae were hatched at home on July 2d. Four small larvae were found in another place on a single leaf a few days thereafter.

HYMENOPTERA. 7. *Dahlbohmia needhami* Ashmead. This species shares the terminal pith cavities with MELANOMMA (No. 1 *ante*), but is much less common. The first specimens were found in winter, hibernating in their cells as pupae. Imagos were bred from these in May. On June 26th I first saw the live wasp. It was a female, busily engaged in excavating the pith in the end of a broken stem. She would descend into the stem and after a few seconds back up to the surface and scatter some fine white pith chips, descend again instantly, and repeat. I marked the place and returned the next day to find her storing her completed nest tunnel with aphids — nymphs of RHOPALOSIPHUM sp? and CHAITOPHORUS sp? I captured her then, and examined the nest, and found one cell completed and closed, and a second one half stored.

The completed nest consists of four or five cells arranged end to end in the cavity, separated by partitions of fine pith chips, the thickness of the partition being about equal to the diameter of the cell. It appears that the first boring into the pith cavity is not of the full diameter of the cells, and that the chips made in finishing the walls of each cell, except the bottom one, are used to form the partition separating it from the one below it.

This species and the three named Hymenoptera next following have been determined by Dr. Wm. H. Ashmead.

8. *Rhogas rileyi* Cress. This big parasite of *Acronycta oblinita* has already

been mentioned under the account of that species. It is sufficiently common to serve as an efficient check upon the depredations of the larvae of that species. The larvae are generally killed before they are grown. My bred specimens of the parasite are labeled the 18th and the 21st of June.

9. An undescribed pteromalid, in the hands of Mr. Ashmead for description. Bred from larvae of *Acronycta oblinita* on the 5th of June.

10. An undescribed pteromalid, in the hands of Mr. Ashmead for description. Bred from pupae of *Dahlbohmia needhami* about the first of May.

11. *Coccophagus flavoscutellum* Ashmead. Bred on the 5th and 6th of June in great numbers from the male scales of *Eulecanium armeniacum* (No. 16 *post*), which they completely annihilated.

12. *Chalcis annulata* Fabr. Found on button-bush stems, but not further observed.

13 *Siobla excava* Norton. A pair of sawflies of this species was captured in July on a well isolated clump of button-bush. A number of sawfly larvae were taken feeding on the same clump on the 27th of June, some of them apparently grown. These larvae fed only on the young and tender leaves of the sterile shoots. They were hardly gregarious, and in their feeding, they ate but a few small holes in each leaf. Mr. A. D. MacGillivray determined the adults, and I have supposed that the larva belong to the same species.

HEMIPIERA. 14. *Neurocolpus nubilis* Say. This species and the two next following were the only ones that appeared to be getting their living exclusively at the expense of the button-bush (*Acronycta oblinita* fed also on the leaves of the tall dock, *Rumex altissimus*, on the island). This rather prettily red-marked capsid was seen feeding about the buds of the flowering shoots, nymphs only being present in May, and adults appearing about the middle of June. Determined by Mr. O. Heidemann.

15. *Aphis cephalanthi* Thos. A few colonies of this aphis were found on flowering shoots that overhung the water. Their bluish powdery covering gave to the shoots which they thickly covered a decidedly glaucous appearance. In the colonies were found foraging the larvae of the anthomyiid (No. 22) and the coccinellid (No. 31) mentioned below.

16. *Eulecanium armeniacum* Craw. This scale was very common during the winter of 1898–99 on shoots of the preceding season; but it was excessively parasitized with *Coccophagus flavoscutellum*, and I have not been able to find a specimen since that season. I placed hundreds of the male scales in a proper breeding cage in April, and hundreds of the parasites emerged, but not a single male scale insect.

17. *Archasia galeata* (Fabr.).
18. *Atymna inornata* (Say).
19. *Atymna querci* (Fitch).
20. *Phlepsius irrorratus* (Say).
21. *Thamnotettix clitellaria* (Say).

These species were all found upon the leaves and, presumably, feeding there. Determined by Mr. O. Heidemann.

DIPTERA. 22. *Leucopsis nigricornis* Egger. The larvae of this little fly were found June 27th in the midst of colonies of *Aphis cephalanthi*, feeding voraciously on the plant lice. Though legless they could adhere to the convex surface of a bare stem or crawl about upon it. The living larvae are whitish, with a covering of bluish powder similar to that of the aphids, and there are on the middle of the back several darker M-marks, connected in the middle by an interrupted middorsal line. Some larvae were observed pupating in the midst of the aphis colony, attaching the puparium to the stem. The puparium is at first yellowish, but later it turns reddish brown. From puparia collected here a number of imagos were bred, and these and the following Diptera have been determined by Mr. D. W. Coquillett.

23. *Epiphragma fascipennis* Say. Larvae of this species are very common under the bark and in the sap wood of watersoaked button-bush stems that lie upon the mud. They are able to burrow through rather solid wood. Larvae of different sizes may be obtained almost any time. Transformation takes place mostly between the middle of May and the middle of June. A full account of this species with figures will appear in my forthcoming second report from the N. Y. entomological field station.

24. *Odontomyia vertebrata* Say. Observed on the flowers; specimens now at hand bear the dates June 2 and 27. The larvae and pupae are taken not uncommonly floating on the surface of the pond.

25. *Eristalis transversus* Wied. 25th June.
26. *Eristalis bastardi* Macq. 21st June.
27. *Helophilus laetus* Loew 21st June.
28. *Tropidia albistylum* Macq. 21st June.
29. *Baccha fuscipennis* Say 31st July.
30. *Chrysogaster nitida* Wied. 21st June.

All found feeding from the flowers, the first very commonly, the last two rather rarely.

COLEOPTERA. 31. Hippodamia 13-punctata (Linné). This coccinellid beetle was not uncommon on the button-bush clumps. Some larvae were observed foraging in the colonies of *Aphis cephalanthi*; imagos were distributed promiscuously. This and the following Coleoptera, have been determined by Mr. Samuel Henshaw.

32. *Telephorus carolinus* Fabr. This lampyrid beetle lives as a larva among the roots of the button-bush, and in the mat of moss that usually overspreads them; it transforms frequently under the bark of a dead stem, sometimes in the pith cavity of a short and thick stub when low enough to be kept sufficiently moist,

and the imagos are commonly taken on the foliage. The species, being carnivorous, probably has no relation to the button-bush except through its relations with other insects.

Larvae were found among the roots and moss in early spring; pupae were found early in May, and one of these, with the larval skin still enveloping the apex of the abdomen, and serving for certain identification, was bred on the 18th of May. About the same time two teneral imagos were found among the moss enwrapping the roots of a button-bush. I have previously recorded (Amer. nat., vol. 34, p. 371) that fully matured beetles are commonly found eating the nectar flowing from weevil wounds at the base of the flowers of the blue flag.

As the immature stages of this interesting beetle seem not to have been described hitherto, and as it is of somewhat different type from the larvae of other well-known Lampyridae, I deem it worth while to add descriptions herewith of larva and pupa.

LARVA: — Length 19 mm., abdomen 11.5 mm., width of head 1.5 mm., of abdomen 3 mm. Body nearly cylindric, dorsum well rounded, widest across the base of the abdomen, and tapering somewhat to both ends. Body segments of nearly equal length, those of the base of the abdomen being slightly shorter and wider, at the sides well rounded, with evident constrictions between the segments.

Coloration obscure; head dark chestnut brown, paler about the base of antennae and mouth-parts. Body olivaceous above, paler below; skin finely granulate and covered with a fine and dense pubescence which gives it a decidedly velvety appearance. Thorax with a pale median longitudinal line, and ( )-marks at the sides of each segment with a large brownish, longitudinally placed, elliptical mark on each side midway between the ( )-marks and the median line. Abdominal segments each with a very narrow, pale, basal, median, longitudinal line or dash, either side of which is a similar oblique, nearly transverse, dash; farther out on the sides of the segments and much farther backward are two broader dashes on either side. These are placed side by side and a sinuous, and continuous, paler longitudinal line extends between them. Farther down upon the sides is a less distinct, similar line in which the spiracles are situated.

Head quadrangular, longer than wide, slightly narrowed just before the hind margin, thinly clad with yellow, spinous hairs. Labral margin squarely truncate, with a low broad quadrangular tooth in the middle, isolated by a minute cleft of the margin either side of it. Mandibles long and strong, regularly arcuate and tapering to a strong point, with a simple strong tooth on the inner border at two thirds their length. Eyes bead-like projections upon the lateral margin at the base of the antennae. Antennae two-jointed spinous, the second joint slightly longer than the first, obliquely truncated at the tip with the longer angle the internal one, and bearing on the end an external flabellum, and a slightly longer, conical rudiment of a third joint which in length about equals the width of the 2d segment. Basal segment of both labium and maxillae lying in one plane and densely covered below with a growth of spinous yellowish hairs. There are abundant hairs also on the ventral side of the mentum of the labium, and on the apical margins of all the remaining segments of both maxillae and labium. The maxillary palpi are 4-jointed, the length of the segments from the base

outward being to each other as 1 : 2 : .3 : 1.2, and their widths being as 1 : .8 : .6 : .4 decreasing to apex, this last segment being conical. The lacinia of the maxilla is oblique at base and straight and conical in its distal three fourths, this part being set off by a constriction on the inner side. The mentum of the labium is trapezoidal, widest in front, where occurs a slight notch on the median line. The basal segment of the labial palpus is cylindric and about as long as the mentum; the 2d segment is a third as long and half as wide at base and tapers to a point.

The legs of the three pairs are alike save for very slight difference in size; femora and tibiae are of equal length coxae one third shorter, trochanters one half shorter, and tarsi two thirds shorter. The tarsus is 1-jointed, including the claw, merely tapering into a straight, and at the last, slightly decurved tip. It is beset about its base by 6–10 stiff appressed spines, while the legs throughout are sparsely clad with yellowish hairs. The 9th segment of the abdomen is one third narrower than the 8th and the 10th is one half the width of the 9th and is short, cylindric, simple.

Pupa:—Length 12 mm., abdomen 8 mm., width of head 2 mm., of abdomen 3 mm. Prothorax placed vertically at the front end of the body, its disc nearly square, with square hind angles and rounded front angles. Head bent under. Antennae essentially as in the adult beetle, but shorter bent in ?-shaped, the upper curve of the ? surrounding the knees of the first and second pairs of legs and lying against the sides of the thorax. The knees of the hind legs project dorsally from under the hind wings, the tarsi of all legs lie near together with soles opposed on the median ventral line. The abdomen is depressed cylindric, at its apex depressed conic, gradually terminating in a pair of straight soft flat spines about as long as the distance between their tips.

The whole surface of the body is smooth. A broad, dark, dorsal band nearly covers the abdomen and there is a line of dashes either side of it. The large spot of the prothorax of the imago appears in the old pupa very distinctly, and also the paler markings about the bases of the antennae and there is a dark blotch upon the metathoracic scutum.

Bred at Lake Forest, Ill., 18th May, 1901.

33. *Macrops porcellus* (Say) ? A standing dead stem of button-bush was found to be infested with larvae, and was put in a breeding cage in the spring and this beetle emerged in the cage. Unfortunately, the gummed label on the vial in which I kept the specimen became loosened and was lost, and with it all further data concerning this insect.

NEUROPTERA. 34. *Sisyra umbrata* Needham. While working in a button-bush clump I one day accidentally injured a tree-frog that was sitting, perfectly concealed by its color, on one of the trunks: and having thus made it necessary to kill the frog, I examined its stomach, and there I found for the first time this species. The frog had eaten six of the spongilla flies. By a little careful searching I soon found a few specimens sitting on the button-bushes. I found also the larvae crawling about on little knot-like growths of *Spongilla fragilis* attached to submerged twigs and trunks of the button-bush as well as to other solid supports of any sort. It is therefore a natural, though quite an incidental associate of the button-bush.

35. *Chauliodes rastricornis* Rambur. Larvae of this species are found occasionally under button-bush trunks that are lying in the edge of the water, and I found one pupa that had ensconced itself neatly in the pith cavity of a stub of large size that projected from the open water. This pupa I reared, the imago issuing on the 31st of May.

ACARINA. 36. An undetermined mite of very small size makes a felted gall on the leaves of the most vigorous shoots. The mites live on the under side of the leaf between the veins in the midst of the reddened hypertrophied plant hairs which fill the concavity that quickly develops. Frequently the gall becomes distinctly sacculate, rising to a considerable height from the upper side of the leaf, and becoming almost a mantle gall. It is of irregular shape, with warty surface, and is reddish in color, or green, tinged with reddish.

Besides the foregoing, there were at least four other species of insects that certainly belong to the button-bush population, but which I have been able neither to find out about, nor to name. These are a jassid whose nymphs were common, feeding on the leaves in June, but which I did not breed. A number of jassid imagos might be swept from the foliage in midsummer, but whether they were there by accident was uncertain; an undetermined coleopterous larva that I took to be one of the Oedemeridae which I found repeatedly under the bark of dead stems; and two species of ants undetermined that were taken often about the colonies of APHIS and EULECANIUM.

HABITS.

The ecological relations of the members of this assemblage of insects are not without interest. A number live in the dead stems only. Of these, four live in the pith cavities of broken stems: two (nos. 1 and 7) in the dry tops, and two (in the pupal stage only, nos. 32 and 35) in the wet stubs. Five live under the bark, three (nos. 1, 3 and 32) as pupae only, and two (nos. 23 and 33) feeding as well as transforming there; two of these live only in wet stems (nos. 23 and 32). Nine of our list (nos. 4, 5, 24–30) are merely flower visitors. Two feed on the green stems and these (nos. 15 and 16) are among the most important enemies of the button-bush. Ten are leaf feeders (nos. 2, 6, 13, 14, 17–21, and 36, the last being the only gall maker observed) and among these only one (no. 2) seemed of much importance to the plant. Of the three prime depredators, therefore, the moth larva (no. 2) and the scale insect (no. 16) have their internal parasites of the usual sort, and the aphid (no. 15) has its predatory larval dipterous (no. 22) and coleopterous (no. 31) foes. Three aquatic insects of our list (nos. 24, 34, and 35) are

natural associates of the button-bush, requiring similar habitat, but their relations with it are of the most tenuous sort. Among all the insects named only three, and these three, Hemiptera (nos. 14–16), appeared to be getting their living entirely at the expense of the button-bush, and of these three the first was not very common, and the other two were beset by most efficient enemies.

THE HEMIPTERA DESCRIBED BY PHILIP REESE UHLER. I.

BY SAMUEL HENSHAW, CAMBRIDGE, MASS.

1860 **1** Hemiptera of the North Pacific exploring expedition under Com'rs Rodgers and Ringgold. Proc. acad. nat. sci. Phil., 1860, p. 221–231.

1861 **2** Homoptera of the North Pacific exploring expedition under Com'rs. Rodgers and Ringgold. Proc. acad. nat. sci. Phil., 1861, p. 282–284.

1861 **3** Descriptions of four species of Hemiptera collected by the North-western boundary survey. Proc. acad. nat. sci. Phil., 1861, p. 284–286.

1861 **4** Rectification of the paper upon the Hemiptera of the North Pacific expedition. Proc. acad. nat. sci. Phil., 1861, p. 286–287.

1861 **5** Descriptions of a few new species of Hemiptera, and observations upon some already described. Proc. ent. soc. Phil., 1861, vol. 1, p. 21–24.

1863 **6** Hemipterological contributions. — No. 1. Proc. ent. soc. Phil., 1863, vol. 2, p. 155–162.

1863 **7** Hemipterological contributions.— No. 2. Proc. ent. soc. Phil., 1863, vol. 2, p. 361–366.

1869 **8** Notices of the Hemiptera obtained by the expedition of Prof. James Orton in Ecuador and Brazil. Proc. Bost. soc. nat. hist., 1869, vol. 12, p. 321–327.

1870 **9** [*Podisus placidus.*] Amer. ent. and bot., 1870, vol. 2, p. 203.

1871 **10** Notices of some Heteroptera in the collection of Dr. T. W. Harris. Proc. Bost. soc. nat. hist., 1871, vol. 14, p. 93–109.

1871 **11** [Salt water Hemiptera.] Amer. journ. sci., 1871, ser. 3, vol. 1, p. 105–106.

1871 **12** A list of Hemiptera collected in eastern Colorado and northwestern New Mexico, by C. Thomas, during the expedition of 1869. Rept. U. S. geol. surv. Wyoming, 1871, p. 471–472.

1872 **13** Notices of the Hemiptera of the western territories of the United States, chiefly from the surveys of Dr. F. V. Hayden. Rept. U. S. geol. surv. Montana, 1872, p. 392–423.

1875 **14** List of the species of Hemiptera and Neuroptera, obtained by Prof. James Orton, in northern Peru. Proc. Bost. soc. nat. hist., 1875, vol. 17, p. 282–286.

1875 **15** Report upon the collections of Hemiptera made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871, 1873, and 1874. Rept. geog. and geol. surv., 1875, vol. 5, p. 829–842, pl. 42.

1876 **16** List of Hemiptera of the region west of the Mississippi river, including those collected during the Hayden explorations of 1873. Bull. U. S. geol. and geog. surv., 1876, vol. 1, p. 269–361, pl. 19–21.

1877 **17** Report upon the insects collected by P. R. Uhler during the explorations of 1875, including monographs of the families Cydnidae and Saldae, and the Hemiptera collected by A. S. Packard, Jr., M. D. Bull. U. S. geol. and geog. surv., 1877, vol. 3, p. 355–475 : 765–801, pls. 27–28.

1878 **18** Notices of the Hemiptera Heteroptera in the collection of the late T. W. Harris, M. D. Proc. Bost. soc. nat. hist., 1878, vol. 19, p. 365–446.

1878 **19** On the Hemiptera collected by Dr. Elliott Coues, U. S. A., in Dakota and Montana, during 1873–74. Bull. U. S. geol. and geog. surv., 1878, vol. 4, p. 503–512.

1880 **20** Remarks on a new form of jassid. Amer. ent., 1880, vol. 3, p. 72–73.

1884 **21** Order VI.— Hemiptera. Standard natural history, 1884, vol. 2, p. 204–296. Riverside natural history, [1888], vol. 2, p. 204–296.

1886 **22** Check-list of the Hemiptera Heteroptera of North America. Brooklyn, 1886. 34 pp.

1886 **23** A new noxious capsid. Can. ent., 1886, vol. 18, p. 208–209.

1887 **24** [*Lygus monachus.*] U. S. dept. agric. Div. ent. Bull. 13, 1887, p. 63–64.

1887 **25** Observations on some North American Capsidae. Ent. Amer., 1887, vol. 2, p. 229–231.

1887 **26** Observations on some Capsidae with descriptions of a few new species. (No. 2.) Ent. Amer., 1887, vol. 3, p. 29–35.

1887 **27** Observations on North American Capsidae with descriptions of new species. (No. 3.) Ent. Amer., 1887, vol. 3, p. 67–72.

1887 **28** Observations on Capsidae with descriptions of new species. (No. 4.) Ent. Amer., 1887, vol. 3, p. 149–151.

1888 **29** Preliminary survey of the Cicadaea of the United States.[1] Ent. Amer., 1888, vol. 4, p. 21–23 : 81–85.

1889 **30** New genera and species of American Homoptera. Trans. Maryland acad. sci., 1889, vol. 1, p. 33–44.

1889 **31** Observations upon the Heteroptera collected in southern Florida by Mr. E. A. Schwarz. Proc. ent. soc. Washington, 1889, vol. 1, p. 142–143.

1889 **32** Observations on the insects of the Bermudas. Heilprin's The Bermuda Islands. Philadelphia, 1889, p. 152–158.

1890 **33** Observations on North American Capsidae, with descriptions of new species. No. 5. Trans. Maryland acad. sci., 1890, vol. 1, p. 73–88.

1891 **34** Observations on some remarkable forms of Capsidae. Proc. ent. soc. Washington, 1891, vol. 2, p. 119–123.

1891–92 **35** Remarkable new Homoptera. Trans. Maryland acad. sci., 1891, vol. 1, p. 143–147.

1892 **36** Preliminary survey of the Cicadidae of the United States, Antilles and Mexico. Trans. Maryland acad. sci., 1892, vol. 1, p. 147–175.

1892 **37** Additions to the family Cicadidae. Trans. Maryland acad. sci., 1892, vol. 1, p. 175–179.

1892 **38** Observations on some remarkable Heteroptera of North America. Trans. Maryland acad. sci., 1892, vol. 1, p. 179–184.

1893 **39** Summary of the collection of Hemiptera secured by Mr. E. A. Schwarz in Utah. Proc. ent. soc. Washington, 1893, vol. 2, p. 366–385.

1893 **40** Hemiptera, Heteroptera of the Death Valley expedition. North American fauna, 1893, no. 7, p. 260–265.

1893 **41** A list of the Hemiptera-Heteroptera collected in the Island of St. Vincent by Mr. Herbert H. Smith; with descriptions of new genera and species. Proc. zool. soc. London, 1893, p. 705–719.

1894 **42** A list of the Hemiptera-Heteroptera of the families Anthocoridae and Ceratocombidae collected by Mr. H. H. Smith in the Island of St. Vincent; with descriptions of new genera and species. Proc. zool. soc. London, 1894, p. 156–160.

1894 **43** On the Hemiptera-Heteroptera of the Island of Grenada, West Indies. Proc. zool. soc. London, 1894, p. 167–224.

1894 **44** Observations upon the heteropterous Hemiptera of Lower California, with descriptions of new species. Proc. Cal. acad. sci., 1894, ser. 2, vol. 4, p. 223–295.

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[1] The continuation, p. 81, adds "Antilles, and Mexico."

1895 **45** An enumeration of the Hemiptera-Homoptera of the Island of St. Vincent, W. I. Proc. zool. soc. London, 1895, p. 55–84.

1895 **46** [Descriptions of new Hemiptera from Colorado.] Bull. 31, Col. agric. exper. station, 1895.

1896 **47** Summary of the Hemiptera of Japan, presented to the United States national museum by Professor Mitzukuri. Proc. U. S. nat. mus., 1896, vol. 19, p. 255–297.

1897 **48** Contributions towards a knowledge of the Hemiptera-Heteroptera of North America.— No. 1. Trans. Maryland acad. sci., 1897, vol. 1, p. 383–394.

1897 **49** [New Hemiptera.] Can. ent., 1897, vol. 29, p. 116–118.

1899 **50** A new destructive capsid. Ent. news, 1899, vol. 10, p. 59.

1900 **51** Aids to a recognition of some North American genera and species of the old family Fulgoridae. Trans. Maryland acad. sci., 1900, vol. 1, p. 401–408.

1901 **52** Some new genera and species of North American Hemiptera. Proc. ent. soc. Washington, 1901, vol. 4, p. 507–515.

CORIMELAENIDAE.

CORIMELAENA.

anthracina, 16–270 Cal.
ciliata, 6–156; 16–270 [Cal.]: San Francisco.
cyanea, 6–157; 16–270 Cal. = coerulescens Stål (1862).
denudata, 6–157 La.
extensa, 6–155 [Mont.]: near Ft. Benton.
incerta, 6–156 Cuba.
minuta, 6–155 Cuba.
obtusa, 44–225 L. Cal.: San Jorge.
renormata, 46–11 Col.: Rist canon.

SCUTELLERIDAE.

AUGOCORIS

poeyi, 6–158 Cuba.

AULACOSTETHUS, 10–93; 18–367.

simulans, 16–272 [Cal.]: vic. San Francisco.

CAMIRUS
consocius, 16–274 (Zophoessa) Ariz.
CHRYSOCORIS
distinguendus, 4–286 (Callidea) pro superbus ‖ Uhler = grandis Thunb. (1783).
superbus, ‖ 1–221 (Eucorysses) Japan: Simoda. = grandis Thunb. (1783).
HOMOEMUS.
bijugis, 13–393 Col.; Neb.
consors, 16–272 ——
ORSILOCHUS
complicatus, 7–361 (Pachycoris) Mex. = variabilis H-S. (1839).
PACHYCORIS
discrepans, 14–282 Peru: W. of Huallaja river.
dissociatus, 5–21 Mex.: New Leon.
stallii, 6–159 L. Cal.: Cape San Lucas. = torridus Scop. (1772).
wilsonii, 6–159 Cuba.
SYMPHYLUS
infamatus, 7–361. Mex.
TETYRA
robusta, 48–383 S. W. Ariz.; Mex.: Sonora.
tristis, 5–21 (Macraulax) Md.: Baltimore. = bipunctata H-S. (1839).

CYDNIDAE.

ADRISA
magna, 1–222 (Acatalectus) [China]: Hong Kong.
AETHUS
communis, 17–379 Cuba: Havana; Fla.: near St. John's river, near Orange Springs; Tex.: Dallas Co.
AMNESTUS
pusillus, 16–278 Ind. Terr.; Tex.; Cuba; E. U. S. south of Cape Cod.
BRACHYPELTA
elevata, 1–222 Cape of Good Hope. = aterrima Forst. (1771).
CRYPTOPORUS, 17–381
compactus, 17–382 Tex.: Galveston Island.
CYDNUS
obliquus, 13–394 (Microporus) Ut.: Ogden.
CYRTOMENUS
obtusus, 17–369 Tex.; Ariz.; Mex.

GEOTOMUS
elongatus, 16–280 (Melanaethus) Cal.
picinus, || 17–391 (Melanaethus) Pa.: York Co. = pennsylvanicus Sign. (1883).
robustus, 17–390 (Melanaethus) Md.: near Baltimore; Mass.: Andover.
HOMALOPORUS, 17–376
congruus, 17–377 Col.: vic. Denver City, w. of Denver; Tex.: Dallas Co.
LOBONOTUS, 17–395
anthracinus, 17–395 Tex.: McLennan Co.
MACROPORUS, 16–278.
repetitus, 16–279; 17–375 [Cal.]: San Francisco; [Md.]: w. of Baltimore.
MELANAETHUS, 16–280 = Geotomus Muls. & Rey (1866).
MICROPORUS, 16–275.
testudinatus, 16–276. Cal.
PANGAEUS
discrepans, 17–386 Ind. Terr.: near Ft. Cobb; Cal.: San Diego; Tex.; Mex.
RHYTIDOPORUS, 17–380
indentatus, 17–380 Cuba; S. Fla.
TRICHOCORIS, 16–277
conformis, 16–277 Cal.: San Francisco.

PENTATOMIDAE.

ACANTHOSOMA
vicinum, 4–286 China: Hong Kong.
ATOMOSIRA, 10–97* = Banasa Stål (1868).
BANASA
lenticularis, 43–174 Grenada.
sordida, 10–98 (Atomosira) ——
BROCHYMENA
harrisii, 10–95 S. C.; Pa.: Lancaster Co. = annulata Fabr. (1775).
CARBULA
humerigera, 1–223 (Pentatoma) Japan: Takanosima.
DINOCORIS
fraternus, 8–321 (Antiteuchus) Near Napo river.
EDESSA
rugulosa, 43–177 Grenada.

EUCHISTUS

conspersus, 48–388 Cal.: vic. San Francisco; Wash.

fissilis, 10–96; 13–396 ——

politus, 49–117 Mass.; R. I.; Pa.; D. C.; S. Md.

EYSARCORIS

intergressus, 39–368 Ut.: Amer. Fork canon; Kans.; Cal.

parvus, 47–258 Japan.

GONOPSIS

affinis, 1–224 (Dichelops) Japan: Simoda.

HALYOMORPHA

mistus, 1–223 (Poecilometis) Japan: Simoda; China: Hong Kong. = picus Fabr. (1794).

HYMENARCYS

crassa, 48–387 Ariz.

LIODERMA, 10–97

congrua, 16–288 (Chlorochroa) Col.

viridicata, 15–830, pl. 42, f. 11 Col.: near Roaring Fork.

LIOTROPIS, 17–399

contaminatus, 48–390 (Dendrocoris) Ariz.: near Tucson.

humeralis, 17–400 Mass.: near Charlestown, Andover, Lynn; N. J.: Egg Harbor; Col.: near Manitou; Md.; Geo.

OPLOMUS

annotatus, 7–362 Cuba.

PERIBALUS

abbreviatus, 13–397 (Holcostethus) Kans.; Col.; Cal.

granulosus, 13–398 (Pentatoma) Mont.; Ut.: near Ogden; W. Terr.; Cal. = sayi Stål (1872).

modestus, 13–396 Ariz.; Kans.; Col.; N. Engl.; E. of the Miss.

splendidus, 5–22 (Zicrona) Cal.

PODISUS

crocatus, 48–384 W. Or.; Wash.; Vanc. Isl.; Cal.

gillettei, 46–12 Col.: Rist canon.

mucronatus, 48–386 Cuba; S. Fla.

placidus, 9–203, f. 124; 49–116 Can.; Wash.; Mass.

serieventris, 10–94 Mass.: Cambridge; Me.; Minn.

PRIONOSOMA, 7–363

podopioides, 7–364 Cal.

RHAPHIGASTER

disjectus, 1–224 [China]: Hong Kong.

COREIDAE.

ACANTHOCEPHALA
confraterna, 10–99 (Metapodius) Fla.
instabilis, 10–98 (Metapodius) Pa.; N. C.
thomasii, 13–399 (Metapodius) Ariz. = granulosa Dallas (1852).

ALYDUS
pluto, 13–401 Col.; Id.; Ross Fork: La.; Kans.

ANACANTHOCORIS, 4–287 pro Anacanthus || Uhler = Homoeocerus Burm. (1835).

ANACANTHUS, || 1–227 = Homoeocerus Burm. (1835).

ANASA
obliqua, 5–23 (Gonocerus) Cal.

BELONOMUS, 8–323
annulaticornis, 8–324 Between Napo and Maranon.

CHELINIDEA, 7–365
vittiger, 7–366 Ut.; [Mont.]: Ft. Benton; Va.; La.

COREUS
humilis, 13–403 (Dasycoris) Col.; Kans.; Cal.

CORIZUS
borealis, 3–284 [Wash.]: E. of Ft. Colville; Arctic Amer. = punctiventris Dallas (1852).
validus, 39–370 Ut.: near Gt. Salt Lake, Alta; Or.; Cal.: Ft. Tejon.
viridicatus, 13–404 Col.; Neb.; Dakota. = hyalinus Fabr. (1794).

DARMISTIDUS, 41–706
maculatus, 41–707 St. Vincent.

HOMOEOCERUS
concoloratus, 1–227 (Anacanthus) China: Hong Kong.
marginatus, 47–260 Japan.
punctipennis, 1–226 (Gonocerus) Japan: Simoda.

HYGIA, 4–287
opaca, 1–226 (Pachycephalus) Japan: Takanosima.

MOZENA
obtusa, 16–296 Tex.; N. Mex.: region of Rio Pecos river.

OCHROCHIRA
fuliginosa, 1–225 (Discogaster) ———

PACHYCEPHALUS, || 1–225 = Hygia Uhler (1861).

PLINACHTUS
similis, 47–261 Japan.

RIPTORTUS
annulatus, 1–225 (Camptopus) Japan: Simoda. = clavatus Thunb. (1783).
SCOLOPOCERUS, 15–832
secundarius, 15–833, pl. 42, f. 5 Ariz.: vic. Gila river.

BERYTIDAE.

ACANTHOPHYSA, 40–261
echinata, 40–261 Cal.: Argus mts; near Los Angeles.
JALYSUS
decurvatus, 10–100; 13–402 (Neides) N. H.: Dublin. = muticus Say (1832).
METACANTHUS
capitatus, 43–181 Grenada.
PRONOTACANTHA, 40–260
annulata, 40–260 Cal.: Argus mts.; Ariz.
PROTACANTHUS, 41–707
decorus, 41–708 St. Vincent.

LYGAEIDAE.

APHANUS
boniniensis, 1–228 Bonin islands.
BATHYDEMA, 41–709
socia, 41–710 St. Vincent.
BELONOCHILUS, 10–104
CNEMODUS
sobrius, 44–241 L. Cal.
DYCODERUS, 52–507
picturatus, 52–508. Ariz.: near Phoenix; Col. near Denver.
EREMOCORIS
planus, 47–263 Japan.
GEOCORIS
decoratus, 17–410 [Col.]: Clear Creek canon.
varius, 1–229 (Opthalmicus) Japan: Simoda.
GRAPTOSTETHUS
ornatus, 1–227 (Lygaeus) China: Hong Kong. = servus Fabr. (1787).

HELONOTUS, || 16–312 = Phlegyas Stål (1865).

HETEROGASTER

behrensii, 16–312 (Phygadicus) Cal.

LIGYROCORIS

diffusus, 10–101 (Plociomerus) N. H. = sylvestris Stål (1874).

terminalis, 47–262 Japan.

LYGAEOSOMA

solida, 40–262 Cal.: Mariposa co.

LYGAEUS

admirabilis, 13–405 Col.

confraternus, 8–325 Between Napo and Marañon.

melanopleurus, 40–262 Col.: Panamint mts.

rubicollis, [illegible]244 (Melanocoryphus) L. Cal.: Cape San Lucas, San José del Cabo.

NYSIUS

angustatus, 13–406 Col.; Dakota; Can.

inaequalis, 43–183 Grenada; Fla.; Cuba.

minuta, 46–22 Col.: Ft. Collins, Pleasant valley, The Rustic, Estes Park, Grand Junction, Col. Springs, Montrose, Steamboat Springs; Dak.; Cal.; Can.; N. Engl.; N. Y.; N. J.; Md.; Va.; N. C.; Tex.

providus, 43–182 Grenada.

strigosus, 44–238 L. Cal.: San Julio.

ORTHAEA

maculifera, 1–228: 4–286 China; Hong Kong.

OZOPHORA, 10–102

picturata, 10–102 Mass.: Cambridge.

unicolor, 44–242 L. Cal.: San José del Cabo, Cape San Lucas.

PACHYGRONTHA

antennata, 1–229 (Peliosoma) Japan: Simoda.

similis, 47–264 Japan.

PACHYMERUS

albomarginatus, 1–227 Japan: Takanosima.

PAMERA

nitidula, 40–262 Cal.: Argus mts.; Tex.; N. Mex.

PELIOPELTA, 22–15 pro Helonotus || Uhler = Phlegyas Stål (1865).

PELIOSOMA, 1–229 = Pachygrontha Germ. (1837).

PERITRECHUS

fraternus, 10–103 Mass.: Cambridge.

PHLEGYAS

abbreviata, 16–313 (Helonotus) Neb.; Mo.; Ill.; Mich.; Mass.; N. Y.; Can.: Grimsby; N. J.; Md.; N. C.; Pa. = annulicornis Stål (1874).

PTOCHIOMERA

clavigera, 46–24 Col.: Ft. Collins, Poudre Canon, vic. Denver and Manitou; N. Y.; Tex.

PYGAEUS, 43–187

pallidus, 43–187 Cuba; Tex; Fla.; Mass.: Tewksbury; L. Can.; Md.; Grenada.

RHYPAROCHROMUS

floralis, 46–26 Col.: Ft. Collins; Mont.; Cal.

sodalicius, 15–835, pl. 42, f. 2. (Megalonotus) Cal.: Owen's valley Nev.: Virginia City; Or.; Tex.

SPHAEROBIUS, 41–710.

gracilis, 41–711 St. Vincent.

insignis, 13–407 (Heraeus) Ut.: Ogden; Col.; Can.; Minn.

TOMOPELTA, 41–708

munda, 41–709 St. Vincent.

PYRRHOCORIDAE.

DYSDERCUS

annuliger, 43–189 Grenada

lunulatus, 5–24 Mex.? = albidiventris Stål (1854).

CAPSIDAE.

AGALLIASTES

apiatus, 46–53 Col.: Ft. Collins, Manitou, Steamboat Springs; Kans.

associatus, 13–419 Ut.: Ogden.

decolor, 39–380 Ut.: Amer. Fork; Cal.: Los Angeles.

fumidus, 46–54 Col.: Steamboat Springs.

obliquus, 39–378 Ut.: Wasatch.

signatus, 46–55 Col.: Manitou.

stigmosus, 39–379 Ut.: Amer. Fork.

uniformis, 39–379 Ut.: Amer. Fork.

ASCIODEMA

inconspicua, 39–376 Ut.: Amer. Fork.

ATOMOSCELIS

pilosulus, 39–377 Ut.: Amer. Fork.

BOLTERIA, 26–33
amicta, 26–34 N. Mex.
picta, 39–373 Ut.: Amer. Fork.
CALLODEMAS, 46–33
laevis, 46–33 Col.: Glenwood Springs; N. Mex.
CALOCORIS
palmeri, 13–410 Ariz.
superbus, 15–838, pl. 42, f. 3 Cal.: Owen's valley.
tinctus, 46–34 Col.: Estes Park.
variabilis, 47–267 Japan.
vigens, 44–255 L. Cal.: San José del Cabo.
CAMPTOBROCHIS
grandis, 25–230 Md.; Can.: Ontario; Mo.; Ohio; B. Amer.; Vanc. Island; Va.
nebulosus, 13–417 ———
robustus, 46–39 Col.: N. Park, Leadville, Cameron Pass.
schwarzii, 39–375 Ut.: Amer. Fork; Wash.: near Ellensborough [= Ellensburg]; B. Col.
CLOSTEROCORIS, 33–76
ornata, 33–77 Cal.: near San Francisco, Los Angeles, near San Diego, Ft. Tejon; L. Cal.: Island of Santa Cruz.
COCCOBAPHES, 18–401
sanguinareus, 18–401 N. H.; Can.; N. C.
COLLARIA
coracina, 18–398 (Nabidea). N. H.
explicata, 25–230 Cuba; San Domingo.
COMPSOCEROCORIS
roseus, 44–253 L. Cal.: San Borgia; [Cal.]: Los Angeles.
COQUILLETTIA, 33–78
insignis, 33–79 Dak.; Id.; Col.; Mont.; Cal.: Los Angeles, Santa Barbara.
CYLLOCEPS, 41–711
pellicia, 41–712 Cuba; St. Vincent; S. Fla.; San Domingo.
CYRTORRHINUS
marginatus, 46–43 Col.: Steamboat Springs; [Can.]: Quebec; B. Amer.: Gt. Slave Lake.
DACOTA, 13–413
hesperia, 13–414 Col.; Dak.
DERAEOCORIS
cerachates, 44–265 L. Cal.: San José del Cabo; Cal.: Los Angeles.

REVIEWS.

A Nature Wooing at Ormond by the Sea. By W. S. Blatchley, State Geologist of Indiana. 245 pp., 12 pl., 62 cuts, map. Indianapolis, Nature Pub. Co.

Entomologists contemplating a winter trip south should not fail to read this graphic account of collecting experiences, conditions, and the results obtained during March and early April in the vicinity of Ormond, Fla. In addition to the many interesting biological notes incorporated in the text there are appended lists of the Odonata (18 species), Orthoptera (30 species), Heteroptera (20 species), butterflies (27 species), and Coleoptera (55 species), secured. In this appendix the author has unfortunately published the description of a new species (*Eritettix sylvestris* — Acridiidae), a practice which cannot be abandoned too soon. The proper place for such publication is in the columns of the regular scientific journals or other works of recognized technical character.

In addition to the entomological notes the volume contains an account of the Ormond shell mound and sufficient information of general interest to entitle it to a place in the luggage of every tourist. A. P. MORSE.

Monographie des Cynipides d'Europe et d'Algérie. Par l'Abbé J. J. Kieffer. Tome Premièr. A. Hermann, 6 et 12, rue de la Sorbonne, Paris, France.

This important work, representing volume 7 of André's Species des Hyménoptères d'Europe et d'Algérie, has just been received.

Unfortunately, not many Americans are yet familiar with this great work of André, which was begun some years ago by Mons. Edmond André, and since his death, is being completed by his brother, Mons. Ernest André, a noted hymenopterologist, who has engaged some of the best European specialists to help him out in certain families: Rev. T. A. Marshall in the Braconidae, Robert du Buysson in the Chrysididae, etc.

The volume before us is written by Abbé J. J. Kieffer, better known for his work in the Diptera, and treats of two subfamilies of the Cynipidae or gall-making wasps — the Ibaliinae and the Cynipinae. It is a large octavo, contains 678 pages, and is illustrated by 27 plates, each plate being crowded with figures showing the structural characters of these wasps and the galls or deformations caused by them on various trees and plants.

The work is admirably planned. After a brief introduction Abbé Kieffer enters minutely into the general characters of the Cynipidae: the head, thorax, abdomen, and their appendages are taken up in order and accurately and fully defined.

Before entering into the systematic account of these insects, he discusses fully their early stages — the egg, egg laying, larva, and pupa. The biology of the Cynipidae should come in here but is only briefly touched. The Abbé, however, says: "Nons ne donnons ici que généralities sur la biologie des Cynipes, en nous reservant de traiter cette question plus longuement plus tard pour chacune des cinq tribus dans lesquelles on réparti ces insectes."

A good bibliography of the Cynipidae follows; this appears to be fairly complete, the list of papers given numbering 342. No reference, however, is made to Saussure's genus Oberthürella, described from Africa, a remarkable form falling in my subfamily Liopterinae.

Abbé Kieffer gives a good resumé of the various schemes of classification proposed for these insects, and has recognized five tribes, viz.: (1) Ibaliinae (2) Cynipinae, (3) Allotriinae, (4) Encoilinae, and (5) Figitinae.

This arrangement is good; it is substantially Förster's classification, who called the tribes families, Ibalioidae, Cynipoidae, etc., except that Förster had two additional families, the Megapelmoidae and the Onychioidae. Kieffer has evidently merged these with his tribe Figitinae, to which they are undoubtedly closely allied, having originated from a common stem.

In the opinion of the writer, the families of Förster are *natural groups*, although probably not of equal value, and all should be accepted in the sense of tribes and subfamilies. The termination of these natural groups, whether in oidae, ida, ides, idae, ina, inae or ini, is of secondary importance, until a uniform system, for indicating families, subfamilies and tribes, is established.

The Cynipides of the older authors, I think, represent a superfamily — the Cynipoidea, with two very distinct families, the Figitidae and the Cynipidae, nearly as was first pointed out by Hartig in 1840.[1]

In my own systematic work in the Hymenoptera, I have conscientiously endeavored to define clearly the families, subfamilies and tribes, making use of the endings *idae*, *inae* and *ini* to designate each, respectively, so that no mistake can be made as to what the groups really represent.

The groups recognized by Kieffer as tribes are really natural groups, first pointed out by Thomson and Förster, and should be accepted, whether they be called families, subfamilies, or tribes.

The first subfamily treated by Kieffer is the Ibaliinae; it is represented by only a single species in Europe, while in America we have several species.

[1] *Vide* my arrangement, Proc. U. S. Nat. Museum, XXIII, 1900, pp. 199 *et seq.*

The tribe Cynipinae of Kieffer, includes both the genuine gall-makers (our Cynipinae) and the inquilines or commensals (our Synerginae). He begins with an excellent table for recognizing the galls found on all trees and plants except those found on oak trees; the galls found on the oak are tabulated in a separate table. Each species of oak is then taken up separately and a good table of the galls found on each is given. All the tables are full and clear, and will be found of incalculable value to the student; they make the identification of the numerous European cynipidous galls easy.

Kieffer devotes many pages to the origin, formation, and structure of galls, the uses they are put to, and to heterogenesis and parthenogenesis. It is the most interesting part of the work and should be read by all.

In an excellent dichotomous table of the genera of the Cynipides gallicoles, pages 239 to 257, Kieffer defines 22 genera. He describes one genus, PANTELIELLA, as new. It is allied to DIASTROPHUS, but is easily separated by the mesonotum being longitudinally striate, by the claws being feebly denticulate, and by the relative length of the second antennal joint.

This table of genera does not include all the known genera of the gall-making Cynipids, but only those found in Europe; other exotic genera American, African, etc., not included in the table, are, however, alluded to in footnotes.

In going through this work, one feature that especially commends itself is the compiled list of the commensals and parasites bred from each species of gall that terminates the description. Much time and labor have been expended in compiling these lists; they are, however, of immense value, not only as an aid to the identification of the species, but on account of the great insight they give in regard to the habits and parasitism of the many species involved in these rearings.

Because a parasite is bred from a cynipid gall it does not necessarily follow that it attacks the gall-maker; it may or it may not; it may come from some of the commensals, coleopterous, lepidopterous, neuropterous, etc., often found in galls.

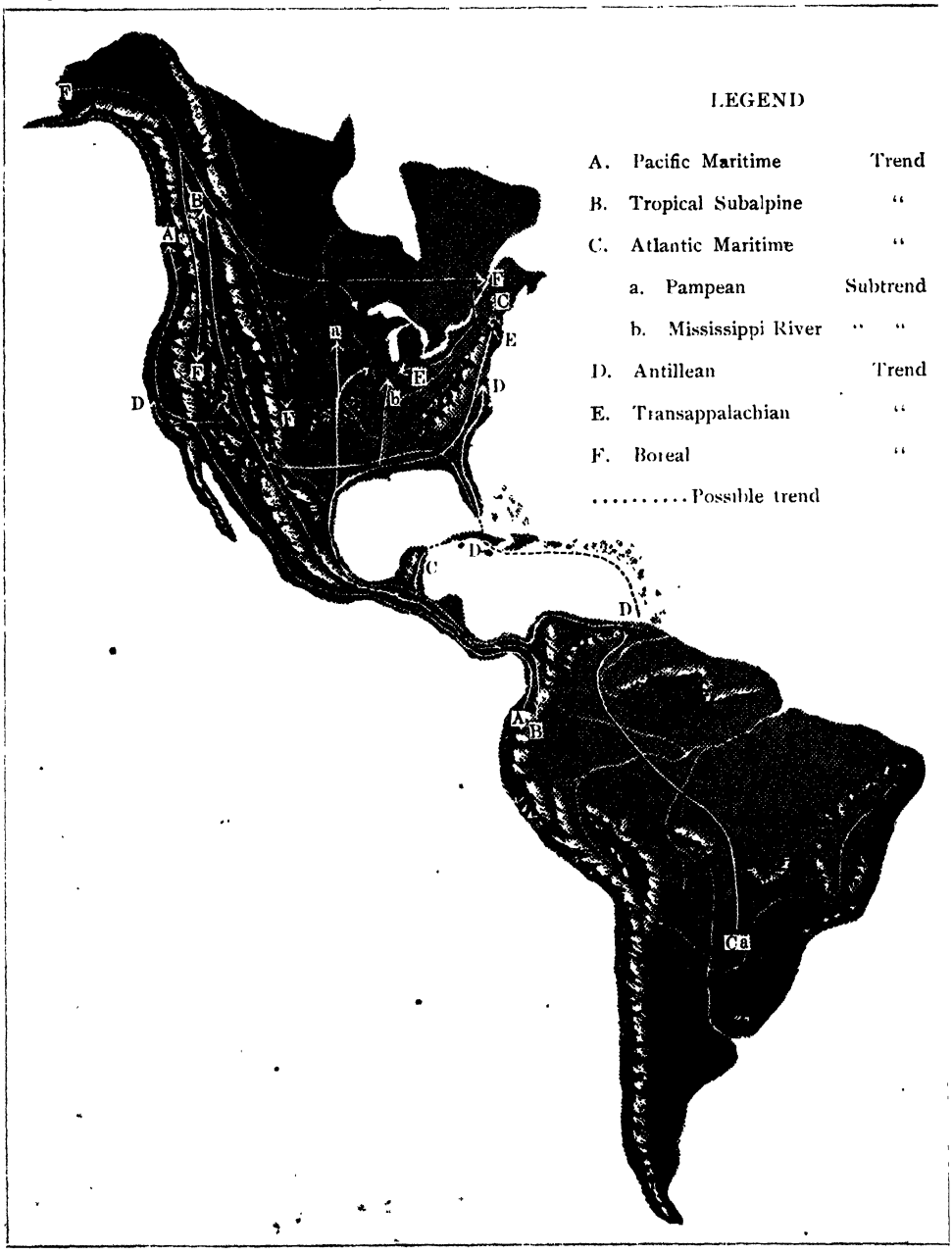
The importance of this is well brought out by Kieffer's list of commensals and parasites bred from a common root-gall on oak, *Biorhiza pallida* Oliver, arranged in two columns. Here it is:

Commensals.		Parasites.	
Coleoptera:	*Belaninus villosus* Fabr.	Hymenoptera:	*Bethylidae*, 2 species
			Ceraphronidae, 2 species
			Platygasteridae, 1 sp.
Neuroptera:	*Hemerobius nervosus* F.		*Torymidae*, 11 species

Lepidoptera:	*Lithosia complana* L.	Hymenoptera:	*Eurytomidae*, 7 species
	Phthoroblastis motacillana Z.		*Encyrtidae*, 3 species
	" *costipunctana* Hw. (= gallicolana 3.)		*Pteromalidae*, 28 species
	Steganoptycha corticana H.		*Eulophidae*, 9 species
	Penthinia profundana Sr		*Ichneumonidae*, 9 species
Hymenoptera:	*Synergus pomiformis* Fonse (= fascialis Hart)		*Braconidae*, 9 species
	" ruficornis Hart		
Diptera	*Clinodiplosis biorhizae* Kief		

The bethylids came from the Lepidoptera, the ceraphronids and platygasteriids from the Diptera, the ichneumonids and braconids from the Coleoptera and the Lepidoptera, etc., etc.

Much more could be said of this important work, the most thorough and interesting yet published on the Cynipidae It must, however, be seen and read to be thoroughly appreciated and should be found in all our libraries. The author is to be congratulated on his splendid work. WM. H. ASHMEAD



WEBSTER:—DIFFUSION OF INSECTS.

PSYCHE.

THE DIFFUSION OF INSECTS IN NORTH AMERICA. Plate 2.[1]

BY F. M. WEBSTER, URBANA, ILL.

The abundance and diversity of insect life during the warmer months are sufficiently striking to attract the attention of even those not especially interested in insects. To others of a more inquiring mind the questions arise as to the means by which they came, and, being here, how it is that they are able to remain. It is to the first proposition that this discussion will be directed.

The careful observer of insect life will not fail to remark the gradual changes that are constantly taking place in the insect fauna of any single area of country. Some species, on account of changed conditions, due largely to the industries of man, are disappearing, while others, before unknown, are, or seem to be, taking their places. Probably there are few scientific men who have not, again and again, had the question put to them in this way: "Is there a constant creation of new insects going on, or are these we see only the old ones?" The question is easier asked than answered, but I shall try to throw some light upon the somewhat obscure problem by an arrangement of a portion of the data at present obtainable, and which tend to throw light upon the subject not so much of insect creation, as of insect diffusion. But at the outset I must call attention to the fact that this kind of research can only follow on after considerable progress has been made in classification, and considerable knowledge obtained of the structure and habits of the forms entering into the problems which we are to study. Again, as elsewhere in the realms of zoological science, it sometimes occurs that affinities may appear in the earlier stages of development and disappear entirely in the later stages. For this reason we cannot even yet in many, perhaps the majority of cases, work out our problems with a feeling of assurance that we have reached conclusions that are final and may not, in the future, need revision. But no progress is made in any science without effort, and some failures are inevitable, so that, generally speaking, the best results are only such until some one else does better.

Insect diffusion began in America a long way back in the obscure past, just how far we do not know, but the remains of an ancient insect fauna have been pre-

[1] Revised from a lecture delivered, February 11, 1903, at the University of Chicago. The map was drawn especially for me by Dr. J. W. Folsom.

served for us in the rocks and shales, so that we are given a point from which to begin our investigations. Perhaps the Tertiary deposits in Wyoming and Colorado, though including but a mere fragment of the vast host of insects that must have been entombed in the rocks, have yielded us the greatest amount of information relative to the ancient fauna of America, containing as they do, and in profusion, not only representatives of every order of insects known to-day, but types of every dominating family which at present exists. We have also been further fortunate in having so faithful a student as Mr. S. H. Scudder to study this material, for it contains not only numberless bodies of the more stable insects like the Coleoptera, but even those of APHIDIDAE and microscopic parasitic insects, whose bodies are of the most fragile nature. We are thus put in possession of facts that go to show that, as to-day, the aphides were probably in part viviparous, and we have besides the special sexual forms of the ants and the triungulin larva of the MELOE thus preserved for us. A study of this material has given us some surprising facts. Among the most significant, and quite apropos to our subject, is the fact that a careful investigation of the Rhynchophora obtained, as compared with the forms now existing in this country, shows that the recent American Rhynchophorous fauna agrees better in its broad features with the Tertiary fauna of Europe than with the Tertiary fauna of America. Though possibly a little in advance of its proper place, it may not be entirely out of order to call attention here to a fact well known to entomologists and especially to lepidopterists; viz., that where a species is found both on the Atlantic and Pacific slopes, and which also occurs in Europe, individuals taken from the Pacific coast region are more nearly like those found in Europe than are those found along the Atlantic coast. In a list of Coleoptera common to both this country, northern Asia, and Europe, published by the late Dr. John Hamilton, in 1889, 487 species were enumerated, and an almost immediate revision of this paper by the Swiss entomologist, M. Alfred Fauvel, added eight more to the list. In these lists, however, no distinction was made between such as were introduced in articles of commerce and such as came in a strictly natural manner. Thus it will be seen that even in Tertiary times, as also in our recent past, there has been a close relationship between the insect fauna of North America, northern Asia, and Europe.

Geologists are in possession of sufficient data to show conclusively that, during some period of the world's history, the region about the Arctic circle enjoyed a climate as temperate as we have at the present time, while the region now included in the northern United States abounded in tropical animal and vegetable life. Thus there might have been, and probably was, a free intercourse between North America and northern Asia via the northwest, and, possibly, with Europe via the northeast; but of this last we are not so certain. At present, while insects from the eastern

hemisphere in many cases readily become naturalized in North America, it is very rare indeed that the reverse is the case. The reason for this is not understood, nor do we know for a certainty how far back in the past these conditions have obtained; but the general opinion among entomologists is, that the trend of diffusion was from the northwest and not toward it.

But there came a tremendous climatic change, and the northern ice sheet plowed its way southward, crushing and grinding the rocks into sand, clay, boulders, and pebbles, leveling down the elevations, filling up the channels of rivers and the beds of lakes, at the same time transforming the once tropical country into that of the frigid north. How long this condition continued we do not know; but while it did continue, all intercommunication from northern Asia and Europe by the way of the northwest was necessarily cut off. Presumably the ice sheet began to melt away along its southern border in the now United States, gradually uncovering the land to the northward. How rapidly this area was again covered by vegetation and reoccupied by animal life we do not know; nor can we state how far beyond the termination of this ice sheet the flora and fauna had been obliged to retreat. We know that, in our day and in case of the present glaciers, one can almost stand on the edge of the ice and collect insects of the temperate zone; but this really proves nothing in the case of the huge ice sheet covering millions of square miles of area and being probably hundreds of feet in thickness. But, be these facts as they may, it seems very probable that the country as fast as it was uncovered by the receding ice became occupied by plant and animal life *from the south.* Indeed, it hardly seems possible that the trend of diffusion could have set in from any other direction; but how much of a basis for this diffusion was left along the south Atlantic and Gulf coasts we do not know.

Reoccupied by plant and animal life, we have a country as first discovered by the white man, comprising an immense inland plain, the eastern border bulwarked by the Appalachian mountain system, low and broken, it is true, and by the much more stupendous and continuous Cordilleran system to the west, open to the Gulf to the south and to the frigid zone to the northward. This area, now known as the basin of the Mississippi River, because of its being largely drained to the south by that river and its tributaries, was comparatively level, and though heavily timbered to the south and east, was scantily or not at all timbered to the west and north. The drainage to the north, being by the Saskatchewan into Hudson Bay and the Mackenzie into the Arctic Ocean, was, perhaps, a less potent factor in the problem of restocking this country with insects. We have now three natural gateways, so to speak, through which insects not introduced by commerce must make their way into North America. These are by way of northern Asia into Alaska, and thence south and east; by way of Central America, through Mexico; and by way of the

West Indies into Florida. Relative to the last I may be permitted to give a word of caution. South American forms may reach Florida by two lines of diffusion; one by way of the Antilles, the other by way of Panama, Yucatan, and Cuba, as illustrated by *Halisidota citripes*.

We will now take up each of these several gateways of natural dispersion and discuss them separately as the northwestern, the southwestern, and the southeastern sources of diffusion, after which we will consider another series of avenues taken by such species as have been introduced into North America through the agency of man.

Diffusion from the Northwest.

(*See map. Boreal trend, F. F.*)

It is obviously impossible to discuss all the species, or even genera, that appear to have come to us, or perhaps rarely gone from us, via this direction. I have, therefore, selected the Coccinellidae, or lady-beetles, as an illustration, for the reasons that the species are common, well known, and generally diffused over North, and in some cases over South, America, and that the family is represented generally over the world, species of the genus Scymnus having been found in America, Europe, New Zealand, Galapagos and Hawaiian islands, and also in the American Tertiary deposits in Colorado and Wyoming. For illustrations I have as a rule selected our most common species. *Coccinella 5-notata* occurs in Siberia, Alaska, Hudson Bay, Greenland, Kansas, Utah, California, and Mexico. *Coccinella trifasciata* occurs in Lapland, Siberia, Oregon, and about Lake Superior. *Harmonia 12-maculata* occurs from Siberia to Hudson Bay and Lake Superior. *Megilla maculata*, one of our most common species, occurs from Canada and Vancouver south to Chile, with a larger variety of it occurring in Brazil. *Eriopis connexa* occurs from Vancouver to the Straits of Magellan, and though confined to the west coast in North America extends to the east coast in South America, and has been taken on the Andes at from nine to ten thousand feet above the sea. The common *Hippodamia parenthesis*, a representative of *H. amoena* in Siberia, occurs from Oregon to Kansas and New Jersey. It is one of our most numerous and beneficial species. *Coccinella 9-notata*, even more abundant and beneficial, occurs from Canada to Guatemala. *Coccinella affinis* occurs from the Lake Superior region southward to Honduras, while *C. sanguinea* occurs all over North America and from Alaska to Patagonia.

Species coming from the eastern to the western hemisphere do not necessarily occupy the same climatic areas in both. The following will suffice to illustrate this

point. *Lina lapponica*, one of the Chrysomelidae, in Europe occurs only in the far north and on the highest mountain ranges, feeding, as with us, on willow; but in North America it has become diffused in the lowlands to the southwest part of the country, from Alaska to Texas. A vile-odored carabid beetle, *Nomius pygmaeus*, occurs only rarely in southern France, Hungary, and Greece, while in North America it is found in the Appalachian mountain system from Georgia northward to Nova Scotia, and in Canada, Washington, and Oregon, thus describing in its distribution an almost complete half circle. How it ever reached this country is still a mystery. These instances are cited here in order to show that it is not at all extraordinary for insects to be found in the far north in the eastern hemisphere and in the far south in the western.

Again, insects found in high altitudes in the tropics may be closely related to others occurring in the lower lands farther to the north. A good illustration of this is offered by a species of Hemiptera belonging to the genus EMESA, found almost directly under the equator at an elevation of 16,500 feet above sea level,—the highest altitude at which animal life has ever been found,— but whose nearest ally is *Emesa longipes*, a bug that is common all over the middle west, and at elevations of not over five or six hundred feet.

DIFFUSION FROM THE SOUTHWEST.

(*See map. A, Pacific Maritime: B, Tropical Subalpine: C, Atlantic Maritime.*)

We will now pass to a consideration of diffusions from the southwest. Central America and Mexico have long seemed to me to be biological headquarters, veritable insect nurseries for the propagation of new species to be sent northward. It is here that we have the greatest wealth of material and, I regret to add, the least knowledge thereof, for these countries are far more healthy for insects than for entomologists. I never see a collection of insects from that country, or read of those that are known to occur there, that I do not devoutly hope that some institution with funds to be devoted to research may have this lack of information brought to its notice.

In discussing the northward diffusion of South and Central American forms, I shall be obliged to select two or three genera as typical, and with but an occasional exception confine myself to them, though others might be chosen as illustrations nearly or quite as satisfactorily.

The old genus HALISIDOTA, among the moths, and DIABROTICA and MYOCHROUS, of the Coleoptera, though perhaps no better illustrations than others, are such as I am best acquainted with, having given them somewhat careful study.

The home of the HALISIDOTA certainly appears to be in South America. There are many forms in Central America and Mexico that require further study before much can be said of their relationships, but that many of the species inhabiting the United States originated in these countries, the offshoots of South American forms, can hardly be doubted. There is a form very closely resembling our *H. tessellaris* and, in fact, Dr. Dyar informs me is sometimes so labeled, which is found from Argentina northward, at least as far as Costa Rica. As we can trace many of our species southward to Yucatan, it seems not unlikely that this may prove to be the stem from which both *H. tessellaris* and *H. citripes*[1] have sprung. It will be observed that the former has spread over the eastern United States, and the latter to Texas and Florida, by what appear to be two separate courses, one almost directly north and the other east by way of Yucatan and Cuba into Florida (Atlantic Maritime, C. C. C. and a, b, on map). In the north Atlantic coast region *H. tessellaris* has thrown off what is known as *H. harrisii*, the adults of which cannot be separated; but the larvae of the latter can subsist only on the foliage of the sycamore, while those of the former will perish if placed on the sycamore. *Halisidota caryae* follows almost exactly the distribution of *H. tessellaris*, but there is evidently a splitting up somewhere in Central America, as *H. agassizii* (Pacific Maritime? A. A, on map), which closely resembles it, extends northward into California, where it appears to be displaced by *H. angulifera* with its variety *alni*, the former being the low coast form and the latter the mountain form of *H. maculata*, which last species extending into the mountain regions of Oregon, Washington, and British Columbia, sweeps broadly to the eastward through the extreme northern United States and Canada to Nova Scotia and New England. If this theory is correct, we have a species entering North America from Central America, passing north along the Pacific coast to British Columbia, and making its way east and south with the tide of diffusion from the northwest. Dr. Harrison G. Dyar, of the United States national museum at Washington, to whom I am indebted for information on this point, thinks it quite possible that *H. maculata* may have originated in this manner and that *H. agassizii* is the stem, there being somewhere to the far south a connecting link between the latter and *H. caryae*.

What may be termed the *H. argentata* system (Tropical Subalpine, B, on map) extends from southern Mexico to Vancouver, sending out *H. subalpina* into Arizona and Colorado, and the coast species, *H. sobrina*, into California. Another system, *H. edwardsii*, in all probability emanates from *H. hemihyalea*, in southern Mexico or even farther south, extending into the Sierra Nevadas of California, but down in Mexico *H. labecula* is thrown off, and extends along the Rocky Mountains north into New Mexico and Colorado.

[1] According to Dyar's latest list this is found in South America.

What is now known as *Phyoptera astur* Cramer occurs in South America north to Arizona and New Mexico. *Heterocampa biundata* occurs from Panama through Guatemala and Mexico to Florida and New England. *Macrocampa marthesia* is known from Brazil through Central America to Texas, Georgia, and Maine. The two latter species do not occur on the Pacific slope.

The genus DIABROTICA, of the Chrysomelidae, offers some good illustrations of the diffusion of species of Coleoptera from the far south to the north into North America. There are in Columbia and Venezuela, about one hundred known species of DIABROTICA, of which eleven extend into Guatemala, eight into Mexico, and one into the United States. Several of our most common species of this genus can be traced directly to Central America, *D. longicornis* having been found in Yucatan. In fact, with but a single exception all of our fifteen North American species can be traced into Mexico, and some even farther. Only recently a Mexican species, *Diabrotica peregrina*, has been found just over the Rio Grande River, at Brownsville, Texas. Elsewhere (Journ. ent. soc. N. Y. vol. 3, p. 158–160; vol. 4, p. 67) I have discussed the diffusion of the genus at considerable length, and it is unnecessary to repeat here what was there stated, except to call attention again to the fact that our *D. vittata* has a very close relative in *D. trivittata* on the Pacific coast, and that our *D. 12-punctata* has an equally near relative in *D. soror*, also of the Pacific coast, while in each case there is an intermediate species that seems to connect the two. This phenomenon I attribute to the fact that the original stem species may have become separated far to the south, and one branch followed the Pacific and the other the Atlantic Maritime trends, and Professor Cockerell's *D. vittata* var. *incerta*, coming between the former and *D. trivittata*, would seem to give us an illustration of an intermediate species in the process of evolution, while in *D. tricincta*, which occupies a similar relation to *D. 12-punctata* and *D. soror*, the evolution has advanced further and we have what we term a good species. From some more recent studies of *Myochrous denticollis* and allied species of that genus, it would seem that something similar might have taken place with reference to the northeastward trend of diffusion. Since mapping the distribution of the genus MYOCHROUS in the United States, in 1901,[1] I have found that *M. squamosus* occurs in Illinois and Kentucky, thus indicating that the latter, like *M. denticollis*, has swept broadly to the north and eastward.

The common *Dynastes tityus* occurs from Brazil through Central America and Mexico, and in the United States from Texas to Illinois and east to southern New York and New England. The Cotton boll weevil, *Anthonomus grandis*, which is spreading its devastating hosts through the cotton fields of Texas, was unknown on

[1] Journ. N. Y. ent. soc., 1901, vol. 9, p. 127–132, pl. 9.

this side of the Rio Grande up to a few years ago, when it began its depredations in the vicinity of Brownsville, Texas. Among the Hemiptera or true bugs the Chinch-bug and the Harlequin cabbage-bug offer excellent illustrations of the trend of insect diffusion from the southwest.[1]

Diffusion from the Southeast.

(*Antillean trend, D, on map.*)

Of the remaining entrance gate, that of southern Florida, I will say that there is no doubt that many species have made their way up through the Antilles from South America. The distribution of *Calidota strigosa* illustrates that fact, and there are many other illustrations; but as the United States has recently gained such a supremacy in the Greater Antilles, we may confidently look for considerable activity in the study of the insect fauna of these islands, and I would rather not anticipate the results of this work. I believe, however, that we shall find the Central American and Mexican route the more important.[2]

In taking up the introductions by the agency of man, I should like to approach that subject by here calling attention to what appears to have been such an introduction of *Aphodius lividus*,[3] which must have become established at a point somewhere in the West Indies, from whence it has spread to Florida, and from there pushed its way westward to extreme southern California, entering the state at a point where the mountains are more easily passed through, and started up the Pacific coast. This is a new line of diffusion, and quite a suggestive one as well.

The Eastern Gateway, and the Diffusion Westward of Species Introduced Through the Agencies of Man.

(*The Transappalachian trend, E, on map.*)

I have recently discussed this trend of diffusion quite at length[4] and it is unnecessary to repeat what I have there stated, except to state that the Appala-

[1] See my paper published in the Journal of the Cincinnati society of natural history, vol. 18, p. 141-155.

[2] Probably a majority of the Sphingidae came by the way of the Antillean trend. Their long, slender, powerful wings, like those of sea birds, such as the Albatross and Frigate bird, especially fit them for such a journey. The family is a tropical one and has spread from its ancient home to nearly all countries. That these insects are often obliged to brave the sea is shown by the fact that a French gentleman once showed Dr. Hermann Behr, of San Francisco, a collection of insects caught on shipboard after a heavy gale, fifty-four geographic miles off the coast of Brazil. Every one of the insects were sphinges, belonging to three genera.

[3] Also occurs in Transvaal, South Africa.

[4] Thirty-second Rept. ent. soc. Ont. p. 63-67, 1901.

chian system does not approach the Gulf coast at its southern terminus, but leaves a broad avenue that enables species moving eastward to pass on along the Gulf to the Atlantic coast and thence northward. It does, however, to the northward form an almost impassable obstruction to the directly westward migration of insects from east to west, broken only in the State of New York and the country adjacent to the north and south shores of Lake Erie. Here we have a huge gateway through which nearly or quite all species imported from Europe, landing on our eastern seacoast, north of the mouth of the Potomac River at least, make their way into the comparatively level country beyond. Even the Atlantic Maritime brachypterous Chinch-bug followed this trend. It is barely possible that the valley of the Big Kanawha River in West Virginia and Cumberland Gap may offer passageways for an occasional species, but of this we have no proof as yet. In the Cordilleran system there do not appear to be any such openings or gaps for the influx and diffusion of migrating species, except, perhaps, in extreme southern California and Arizona, a country so arid that few species can take advantage thereof if it really exists; hence, a separation in South or Central America usually remains permanent, while in the case of European species and the Appalachians, they might easily make their way south along the Atlantic coast to the Gulf, and in a comparatively short time mingle with the northern branch that has made its way west to the great lakes and thence southward.

A peculiar feature of the problem of introduced insects is that, although we may have knowledge of their habits in their native homes, this is not always to be taken as limiting their actions in this country. The well-known household pest, the carpet beetle, *Anthrenus scrophulariae*, occurs along the Pacific coast, having doubtless been introduced from Asia, but it does not there attack carpets. Soon after it was introduced into the country along the Atlantic coast it began to destroy carpets at a terrible rate, and it is now one of the most destructive of household pests. I can well remember when it was unknown in Illinois, where now it does much injury. In its native home it is a flower-frequenting insect, and I can always find these beetles here in the United States in early spring in the blossoms of tulips, more especially those of a white color. The allied species, *Anthrenus varius*, also introduced, though a noted museum pest, is at about the same season to be found frequenting the blossoms of the Spiraea. These illustrations go to show the extreme flexibility of insects, not only in the matter of food but nearly every other condition that enters into the problem of their diffusion and development. Generally speaking, insects are as plastic as clay in the hands of the potter, and we need only to look to their immense numbers and variety to find proof of this. They make their way over mountain, plain, and desert and are carried hither and yon by the waters of rivers, lakes, and oceans, possibly to change their specific

identity, as species are understood by the present-day entomologist. If a foreigner lands in Quebec, Canada, or Baltimore, Maryland, it will sooner or later find its way to Buffalo, New York, and westward along the shores of Lake Erie, into the great level country beyond the Appalachians, feeding probably, but not necessarily, on the same food plants that it ate in its home in the eastern hemisphere.

In the eighteenth century it was thought sufficient for naturalists to state that such and such species inhabited North America. In the nineteenth century we decided that we must state whether a species was found in Connecticut or Rhode Island, but it would suffice if the statement were made that it was found in Illinois, notwithstanding that there is more difference between the insect fauna of northern and southern Illinois than there is between the latter state and Ohio. In the beginning of the twentieth century we have come to the conclusion that labels, giving the states only, without more explicit information as to localities from which the specimens to which they are attached have been obtained, are of little value to the student of morphology, or in tracing out the distribution of species; nevertheless we cannot entirely overcome the old prejudice relative to political lines forming biological boundaries. At present, there is nothing for the American entomologist beyond the Rio Grande River. Of course we know that there are insects there, but, by an unwritten law of our own construction, we prohibit ourselves from knowing much of their identity or affinities to species found on our own side of that river. Mexican and Central American species are either excluded from our collections, or, if admitted, are crowded down in the corners and labeled, if indeed at all, as foreign! Thus the most interesting territory in the western hemisphere and what to us is really the most significant, as from out of it whole genera of our insect fauna have been evolved, remains almost a *terra incognita*. Let me illustrate. A phytophagous species starts from South America on its way northward. Even while passing through Central America as well as through Mexico, it is obliged to encounter a diversity of climate, elevation, and food supply. The species in adapting itself to these modifying influences becomes shattered as it were and the fragments are found in Texas, in New Mexico, Arizona, and California. We find these and with the least possible delay, and with no knowledge of their affinities or, in many cases, developmental stages, they are described as so many species and added to our checklists. Can stability in our nomenclature be expected as long as these conditions continue? These same influences are at work in California, and we can see their effects plainly enough there, though both conditions and results are only modifications of what is probably going on farther to the south, and they are of proportionally less value in aiding us to solve our problems in biology and nomenclature. Other modified influences, similar to those at work in California, may be noted in connection with the Antillean and Boreal trends of diffusion, but

none of these, nor in fact all of them combined, appear to influence our entomological fauna to the extent that is probably exerted by the southwestern trend of diffusion. The Transappalachian trend of diffusion appears not to exert any such influences, and individuals of introduced species do not vary from those in their ancient home in the eastern hemisphere.

I have attempted to make my position more clear by the construction of a map that shows the various trends of diffusion of which I have spoken. Since so little is known of species occurring in Mexico, Central America, and the Antilles, and their affinities to our own, it is folly to expect that such a map can be made more than tentative, but it is a beginning. Criticism will provoke investigation, and, in any case, some good must come of it and our knowledge be increased. It is not to be supposed that the area covered by these lines is proportionate to the territory covered by the diffusion itself; the lines only indicate directions.

The Pacific Maritime trend of diffusion may include such species as inhabit this coast or such as are forced down or drift down from the higher areas and establish themselves. Some, like *Halisidota angulifera* in California, have a subalpine form, like *H. alni*. The Chinch-bug also is not confined to the sea level, but probably finds the least resistance to its progress there. This trend of diffusion is indicated on the map by the line A. The Atlantic Maritime trend is to be looked upon as occupying a similar position on the east coast, and may be the avenue along which the Pampean forms make their way from the level areas of South America into those of a similar character in North America. But there is probably the same intermingling of tide water and subalpine forms as on the west coast. It must be continually kept in mind that, though the two coasts are, in Central America, often separated by comparatively short distances, yet the climate is as different as might be expected to exist between localities hundreds of miles apart. This latter trend is indicated on the map by the line C, and the Pampean range by a, because insects that subsist on grasses, or such plants as are to be found in treeless areas, will be more likely to push northward along the base of the rocky mountains and then spread broadly to the eastward than will arboreal species that must hold more closely to the wooded sections. Thus, the Diabroticas evidently hold to the north from Mexico, while the Halisidotas must keep to the eastward. Both may spread up the Mississippi River, as the country is both wooded and grassy. As I have shown elsewhere, the Chinch-bug may have followed both the Pampean, a. a, or the main trend, C. Of course the Mississippi River trend, b, lay open to it, but inundations would probably have impeded its progress. The Tropical Subalpine trend may be illustrated by the *argentata* system of the Halisidotas, and by other forms of the high altitudes. The Antillean trend, D, is illustrated by the many tropical species that have clearly entered Florida from the south, and not by the way of

Central America and Cuba, the latter being a branch of trend C, the possible course of D being indicated on the basis of the trend of diffusion of the introduced *Aphodius lividus*. *Cylas formicarius*, the pest of the sweet potato, may have followed this course, but of this the proof is lacking. The Antillean trend may, and again may not, extend northward, as in C. What I have termed the Transappalachian trend, E, is intended to indicate the trend of diffusion especially, though not exclusively, of species introduced through the agencies of man. Most of these, whether they become established along the coast from Virginia northward, or in Canada as far up the St. Lawrence river as Quebec, make their way into New York and west, passing between the low mountains and the south shore of Lake Erie into the comparatively level country beyond. The Boreal trend, F, from the northwest, may perhaps follow more closely to the coast, as indicated by the dotted line, but sooner or later it sweeps broadly to the east to the Atlantic coast and New England, not infrequently sending subtrends into California, Colorado, and even Mexico. I have not indicated southward trends so fully, because there are less of them; they are less important to this discussion, and too many lines, especially in the far south, would complicate and obscure the map, the land as shown being too narrow to display them clearly separated.

Illinois State Laboratory of Natural History,
Urbana, Ill., Mar. 9, 1903.

CLASSIFICATION OF THE GALL-WASPS AND THE PARASITIC CYNIPOIDS, OR THE SUPERFAMILY CYNIPOIDEA. II.

BY WILLIAM H. ASHMEAD, A. M., ASSISTANT CURATOR, U. S. NATIONAL MUSEUM.

Subfamily IV. — Liopterinae.

1894. Liopterinae, Subfamily IV, Ashmead, Proc. ent. soc. Washington, vol. 3, p. 17.

This group was first recognized as a subfamily by the writer about ten years ago, and I am surprised therefore, to see that Dr. von Dalla Torre takes credit for it in Wytsman's Genera Insectorum, Family Cynipidae, received January 27, 1903. He, and some other writers, placed the group in the subfamily ANACHARINAE, but its resemblance to that subfamily is merely superficial, the attachment of the abdomen, the abdomen itself, and the antennae being quite different.

In the publication quoted above I suggested that the group was probably an ancient phylum of the Cynipidae whence originated some of the Chalcidoidea, CHALCIS, EURYTOMA, etc. Since the suggestion was made additional evidence supporting it has been found in the African genus OBERTHÜRELLA Saussure, occurring in Madagascar and Liberia, a genus belonging to this group, not mentioned by Dalla Torre or by Kieffer, and which has the hind femora slightly swollen and armed with a tooth beneath, similar to some chalcidoids.

TABLE OF GENERA.

1. Head and thorax coarsely rugose; marginal cell closed
   Scutellum normal, not ending in a spine; hind femora unarmed . 2
   Scutellum ending in a long, acute spine; hind femora armed with a strong tooth beneath, before the middle; ♀ antennae 13-jointed, ♂ 14-jointed. (Africa.) . . . . . Oberthürella Saussure.
   (Type O. lenticularis Sauss.)

2. Discoidal nervure interstitial with the median nervure; ♀ antennae 13-jointed, ♂ 14-jointed . . . . . Liopteron Perty.
   (Type L. compressum Perty.)
   Discoidal nervure *not* interstitial with the median nervure but issuing from the transverse median nervure; ♀ unknown, ♂ antennae 13-jointed, clavate Peras Westwood.
   (Type P. niger Westw.)

Subfamily V. — Eucoilinae.

1861. Eucoilidae, Familia, Thomson, Öfvers. vet. akad. forhl. no. 9, p. 397.
1869. Eucoeloidae, Familie 4, Förster, Verh. zool.-bot gesell. Wien, vol. 19, p. 329, 341.

This group is without doubt the largest and most widely distributed of any in the family Figitidae, the genera and species being exceedingly numerous although but little studied. As soon as the attention of entomologists is directed to the collecting of these obscure wasps and especially in tropical countries we may expect the discovery of many new genera, as is clearly shown by the new genera described here, most of which were recognized in a small collection of these insects taken by Mr. Herbert H. Smith in South America.

The subfamily is at once recognized by the cup-like elevation on the scutellum and by the hind tibiae having two apical spurs, characters not found in any other group.

Table of Genera.

Females 1
Males 61

1. Metathorax normal, not produced, the abdomen at most subsessile — (Tribe II Eucoilinae.) 3

   Metathorax produced into a long neck, the length of the hind coxae, the abdomen abnormally petiolated, the petiole being long and slender, longer than the thorax. (Tribe I. Zamischini.) 2

2. Body of abdomen not large, compressed; ♀ antennae long, 13-jointed, thickened toward apex, slender basally, the third joint shorter than the fourth. (Brazil.)
   Zamischus Ashmead, gen. nov.
   (Type Z. brasiliensis Ashm.)

3. Base of abdomen *with* a hairy girdle 15
   Base of abdomen bare, *without* a hairy girdle
      Mesonotum *with* parapsidal furrows 4
      Mesonotum *without* parapsidal furrows 9

4. Parapsidal furrows distinct to base of scutellum 5
   Parapsidal furrows *not* distinct to base of scutellum, converging and meeting *before* reaching the scutellum, thence to base of scutellum as a delicate carina; cup of scutellum large, marginal cell closed; antennae 13-jointed
   Eucoilidia Ashmead
   (Type E. canadensis Ashm.)

5. Parapsidal furrows converging and meeting at the base of the scutellum 6
Parapsidal furrows almost parallel, or some distance apart to the base of the scutellum 7

6. Marginal cell *closed* along the front margin . . Gronotoma Förster
(Type G. sculpturata Först.)
Marginal cell *open* along the front margin . . Diglyphosema Förster
(Type D. eupatorii Först.)

7. Marginal cell *open* along the front margin 8
Marginal cell *closed* along the front margin
Cup of scutellar large, rounded, its disk concave; antennae 13-jointed, long, subfiliform, only slightly and gradually thickened towards apex
Microstilba Förster
(Type M. bidentata Förster)

8. Mesonotum with *five* carinae; cup of scutellum large, oval or rounded; antennae 13-jointed, filiform, joints 4–12 long oval. (South America.)
Tropideucoela Ashm., gen. nov.
(Type T. rufipes Ashm.)
Mesonotum *without* carinae; cup of scutellum large; antennae 13-jointed, without a distinct club . . . . . Disorygma Förster
(Type D. divulgata Först.)

9. Marginal cell *open* along the front margin 10
Marginal cell *closed* along the front margin 13

10. Scutellum normal, unarmed 11
Scutellum abnormal, armed with *two* horns behind
Antennae 13-jointed, ending in a 6-jointed club
Diceratáspis Ashmead
(Type D. grenadensis Ashm.)

11. Antennae ending in an abrupt club, which is *three* or more jointed . 12
Antennae at most subclavate, without a distinct, abrupt club
Ectolyta Förster
(Type Cothonaspis incressata Thoms.)

12. Club of antennae 3-jointed . . . . . Triplasta Kieffer
(Type Kleidotoma atrocoxalis Ashm.)
Cup of antennae 5-jointed . . . . . Pentaplasta Kieffer
(Type Pentacrita coxalis Ashm.)

13. Antennae ending in a distinct, abrupt club 14
Antennae without a distinct club . . . Erisphagia Förster
(Type Eucoila curta Gir.)

14. Club of antennae 5-jointed (rarely 6-jointed)
Apex of front wings entire . . . . . Psilosema Kieffer
= Cothonaspis Thomson Förster
(Type C. pentatoma Thoms.)
Apex of front wings emarginate or excised . Schizosema Kieffer
(Type Eucoila emarginata Hartig.)

15. Front wings at apex *emarginate* or *excised*; apical abscissa of the submarginal vein stout, quadrate, at the most only a little longer than thick 16
Front wings at apex *entire*, never emarginate or excised although sometimes shortened and truncate; apical abscissa of the submarginal vein slender, not stout, always two or more times longer than thick 23

16. Marginal cell *open* along the front margin 17
Marginal cell *closed* along the front margin
Club of antennae 6- or 7-jointed . . . . Leptopelina Förster
(Type Eucoila longipes Hartig.)

17. Antennae ending in a distinct, abrupt club 18
Antennae filiform or subfiliform, *not* ending in a distinct club
Arhoptra Kieffer
(Type Eucoila melanopoda Cam.)

18. Club of antennae more than 3-jointed 20
Club of antennae 3-jointed
Scutellum normal, *not* produced into a beak at apex . . . 19
Scutellum abnormal, produced into a beak or horn at apex; funicle joints 2–7 small, moniliform . . . . . Rhynchacis Förster
(Type Cothonaspis niger Hartig.)

19. Wings extending far beyond tip of abdomen . . Kleidotoma Westwood
= Trirhoptrasema Kieffer[1]
(Type K. psiloides Westw.)

20. Club of antennae more than 4-jointed 21
Club of antennae 4-jointed . . . . . Tetrarhoptra Förster
(Type T. tetratoma Först.)

21. Club of antennae more than 5-jointed 22
Club of antennae 5-jointed . . . . . Pentacrita Förster
(Type Eucoila cordata Gir.)

22. Club of antennae 6-jointed . . . . . Hexacola Förster
(Type Kleidotoma hexatoma Thoms. = Hexacola picea Först.)

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[1] Kieffer proposes this genus for my *Kleidotoma americana*, which, however, is a true *Kleidotoma*. I am probably responsible for the Abbé's error by describing through a *lapsus pennae* the marginal cell as being closed, when it is really more or less *open* along the fore margin.

Club of antennae 7-jointed . . . . . Heptameris Förster
(Type Eucoila pygmea Thoms.)

23. Wings abbreviated and much narrowed 24
Wings not abbreviated, fully developed and always extending far beyond the tip of the abdomen 28

24. Club of antennae *less* than 7-jointed 25
Club of antennae 7-jointed . . . . . Nedinoptera Förster.
(Type Eucoila holophila Thomson)

25. Metapleura bare, *without* a hairy cushion 26
Metapleura covered *with* a hairy cushion
Marginal cell *not* fully developed, the first abscissa of the radius alone present, or *longer* than the second when the latter is present
Glauraspidia Thomson
(Type G. parva Thomson.)
Marginal cell fully developed, the first abscissa of the radius *shorter* than the second . . . . . Apistophyza Förster
(Type Eucoila microptera Hartig.)

26. Wings extending at least to the middle of the abdomen, and usually *with* a marginal cell 27
Wings *not* extending beyond the base of the abdomen, and *without* a marginal cell; club of antennae 3-jointed . . . . . Aphyoptera Förster
(Type A. inustipennis Förster)

27. Wings shorter than the abdomen, the marginal cell closed
Agroscopa Förster
(Type A. helgolandica Först.)
Wings as long as the abdomen, the marginal cell present but *open* along the front margin; club of antennae 5-jointed . . . Aphiloptera Förster
(Type A. anisomera Först.)

28. Antennae 11-, 12-, or 13-jointed 29
Antennae 14-jointed
Wings bare, glabrous . . . . . Macrocereucoila Ashmead
(Type M. longicornis Ashm.)
Wings pubescent ciliate
Antennae filiform, without a distinct club, the third joint longer than the fourth . . . . . Episoda Förster
(Type E. xanthoneura Först.)

29. Antennae 11-jointed, *filiform* (South America.) Promiomoera Ashm., gen. nov.
(Type P. filicornis Ashm.)
Antennae 12- or 13-jointed

Antennae 12-jointed 30
Antennae 13-jointed 32

30. Marginal cell *closed* along the front margin 31
- Marginal cell *open* along the front margin . . Idiomorpha Förster
(Type I. melanocera Först.)

31. Cup of scutellum large, rounded, the whole disk impressed or concave; antennae filiform, the third joint the longest, or without an abruptly defined club
Miomoera Förster
(Type M. aberrans Först.)

Cup of scutellum large oval, the whole disk not impressed, anteriorly flat, posteriorly with a fovea, with small punctures bordering the margin; antennae ending in an abrupt 7-jointed club . . Paramiomoera Ashmead
(Type P. heptoma Ashm.)

32. Marginal cell *closed* along the front margin 33
Marginal cell *open* along the front margin 50

33. Wings pubescent, the margins fringed or ciliated 34
Wings bare, glabrous, not pubescent or ciliated
Antennae subfiliform not ending in a distinct club, although slightly thickened toward apex, the third joint a little longer than the fourth
Eucoila Westwood.
= Psilodora Förster
(Type E. crassinervis Westw.)

34. Abdomen not unusually compressed, the hypopygium not prominent; second joint of the flagellum usually *shorter* than the first, rarely as long or a little longer 36
Abdomen usually strongly compressed at the sides, the hypopygium most frequently prominent, plow-share shaped; second joint of the flagellum always distinctly *longer* than the first.
Scutellum ending in a spine 35
Scutellum normal
Antennae long, without a distinct club . Hypolethria Förster
(Type Cothonaspis melanoptera Hartig.)

35. Antennae long, gradually thickened toward apex, the third joint only about two thirds the length of the fourth, 4 to 6 long, cylindrical (South America.)
Odonteucoila Ashmead, gen. nov.
(Type O. chapadae Ashm.)

36. Scutellum not ending in a spine 37
Scutellum ending in a spine
Antennae long, gradually thickened towards apex, the third joint much shorter than the fourth . . . . Odontoeucoila Ashmead

37. Flagellar joints *all* long and cylindrical, the last 7 or 8 joints, however, are sometimes stouter and form sometimes a more or less well defined club; first abscissa of the radius distinctly shorter than the second 38

Flagellar joints *not* all long and cylindrical, some oblong oval, ellipzoidal, or moniliform 40

38. Scutellum normal, the cup not modified into a carina 39

Scutellum abnormal, the axillae acutely toothed posteriorly, the cup modified into a carina which is gradually dilated posteriorly, appearing tridentate; antennae long, filiform, the flagellar joints long, cylindrical, the first joint of the flagellum not quite so long as the second (South America.)

Trissodontaspis Ashmead, gen. nov.

(Type T. rufipes Ashm.)

39. Head and thorax finely coriaceous, not polished, the scutellum with two large oblong foveae at base, the cup narrowed ellipzoidal, connected with a carina anteriorly; antennae long, subfiliform slightly and gradually thickened toward apex, the flagellar joints long, cylindrical, the first shorter than the second, third, or fourth which are about equal, the fifth and beyond a little thicker and shorter. (South America.) . . . . . Dieucoela Ashmead, gen. nov.

(Type D. subopaca Ashm.)

Head and thorax smooth, shining, the scutellum with a large oval or round cup; first three joints of flagellum much elongated, and slenderer than the following . . . . . Aglaotoma Förster

(Type Cothonaspis codrunus Först.)

40. Mesonotum *without* furrows or lines 41

Mesonotum *with* furrows or grooved lines.

Marginal cell rather short and broad, the second abscissa of the radius curved . . . . . Chrestosema Förster

(Type C. erythrapum Först.)

41. Cup of scutellum excavated, smooth in front, the anterior part closed, posteriorly with a fovea 42

Cup of scutellum flattened, neither excavated nor margined, slightly arched; metathorax smooth; antennae filiform . . . Ganaspis Förster

(Type G. mundata Först.)

42. Cup of scutellum not extending over the tip of the scutellum; antennae usually *with* a more or less distinct club 43

Cup of scutellum greatly elevated above the tip of the scutellum; antennae *without* a distinct club, usually long . . . . . Psichara Förster

(Type Cothonaspis longicornis Hartig.)

43. First and second abscissae of the radius not nearly equal in length, the first most frequently much shorter than the second 44

First and second abscissae of the radius equal in length or very nearly

Antennae usually with a 7- or 8-jointed club, the joints elongate, cylindrical, the first joint of the flagellum shorter than the second; cup of scutellum usually small . . . . . Rhoptromeris Förster
(Type Cothonaspis eucera Hartig.)

44. Marginal cell not short, much longer than wide 45

Marginal cell rather short, hardly longer than wide, the second abscissa of the radius curved outwardly (South America.)

Zaeucoela Ashmead, gen. nov.
(Type Z. unicarinata Ashm.)

45. Antennae *with* an abruptly defined club; cup of scutellum usually small, narrowed, ovate or ellipzoidal, rarely large oval 46

Antennae *without* an abruptly defined club, filiform or nearly, or only slightly, incrassated toward apex . . . Pseudoeucoila Ashmead, gen. nov.
= Eucoila Auctore.
(Type Cothonaspis trichopsila Hartig.)

46. Club of antennae 7-jointed or less 47

Club of antennae 8-jointed.

Flagellum with joints 2 and 3 very small, together scarcely as long as the first . . . . . Dimicrostrophis Ashmead
(Type D. ruficornis Ashm.)

47. Club of antennae 6-jointed or less 48

Club of antennae 7-jointed.

Flagellum with joints 2 and 3 not small, neither much shorter than the first . . . . . Heptamerocera Ashmead
(Type H. robusta Ashm.)

48. Club of antennae 5-jointed or less 49

Club of antennae 6-jointed . . . . . Hexamerocera Kieffer
(Type Eucoila rufiventris Gir.)

49. Club of antennae 5-jointed . . . . Pentamerocera Ashmead.
(Type P. angularis Ashm.)

Club of antennae 4-jointed . . . . Tetramerocera Ashmead
(Type T. variabilis Ashm.)

50. Marginal cell *closed* at base, the apical abscissa of the submarginal vein distinct 51

Marginal cell *open* at base or confluent with the costal cell, the apical abscissa of the submarginal vein wanting

Second abscissa of the radius usually wanting or much abbreviated; scutellum at apex normal . . . . . Adieris Förster
(Type A. reclusa Först.)

Second abscissa of the radius distinct; scutellum at apex usually emarginate and obtusely bidentate . . . . . Piezobria Förster
(Type P. bicuspidata Först.)

51. Wings pubescent, ciliate 52
Wings bare, glabrous, not ciliate.
Antennae 13-jointed . . . . . Lytosema Kieffer
(Type Eucoila guérinii Dahlb.)

52. Abdomen not unusually compressed, the hypopygium not very prominent 53.
Abdomen much compressed, the hypopygium prominent plow-share shaped; antennae long, subfiliform, the joints elongate; cup of scutellum narrowed, ellipzoidal; cubitus in front wings more or less distinct Pilinothrix Förster
(Type P. designata Först.)

53. Front wings with the cubitus *wanting* 54
Front wings with the cubitus *present*, distinct
Antennae filiform, without a distinct club . . Anectoclis Förster
(Type A. indagatrix Först.)
Antennae subclavate or clavate more or less thickened toward apex, the joints submoniliform . . . . . Cothonaspis Hartig
= Trybliographa Förster
(Type Cothonaspis scutellaris Hartig.)

54. Cup of scutellum normal, not ending in a spine 55
Cup of scutellum abnormal, ending in a long spine
Acantheucoela Ashmead
(Type Cynips armatus Cresson.)

55. Cup of scutellum not large 56
Cup of scutellum large oval or rounded
Antennae clavate, the club not abruptly defined but more than 6-jointed . . . . . Diranchis Förster
(Type D. copulata Först.)

56. Club of antennae distinct, abruptly defined, 3- to 7-jointed . . . 57
Club of antennae not abruptly defined; cup of scutellum small, narrowed ellipzoidal; first two joints of flagellum very slender, shorter than the following . . . . . Hypodiranchis Ashmead
(Type H. hawaiiensis Ashm.)

57. Club of antennae 6-jointed or less 58
Club of antennae 7-jointed . . . . . Heptaplasta Kieffer
(Type Heptamerocera aliena Ashm.)

58. Club of antennae 5-jointed or less 59

Club of antennae 6-jointed . . . . . Hexaplasta Förster
= Didyctium Riley
(Type Cothonaspis hexatoma Hartig.)

59. Club of antennae 4-jointed or less 60
Club of antennae 5-jointed . . . . . Pentarhoptra Kieffer
(Type Eucoila tomentosa Giraud)

60. Club of antennae 4-jointed . . . Tetraplasta Ashm., gen. nov.
(Type T. unica Ashm.)
Club of antennae 3-jointed . . . . . Eutrias Förster

61. Metathorax produced into a long neck the length of the hind coxae, the abdomen abnormally petiolated, the petiole long and slender, longer than the thorax
Zamischus Ashm.

Metathorax normal not produced, the abdomen subsessile.
Abdomen at base bare, *without* a hairy girdle 62
Abdomen at base *with* a hairy girdle 73

62. Mesonotum *with* parapsidal furrows 63
Mesonotum *without* parapsidal furrows 68

63. Parapsidal furrows distinct to base of scutellum 64
Parapsidal furrows *not* distinct to base of scutellum, converging and meeting before reaching the base of the scutellum, thence to base as a delicate carina; marginal cell closed; antennae 15-jointed . . Eucoilidea Ashmead

64. Parapsidal furrows converging and meeting at the base of the scutellum 65
Parapsidal furrows almost parallel or some distance apart to the base of the scutellum 67

65. Marginal cell *closed* along the front margin; cup of scutellum large; antennae 15-jointed, the first flagellar joint longer than the second, excised towards base
Gronotoma Förster

Marginal cell *open* along the front margin; antennae 15-jointed
Diglyphosema Förster

66. Marginal cell *open* along the front margin 67
Marginal cell *closed* along the front margin
Cup of scutellum large, rounded, its disk concave; antennae 15-jointed, the third joint longer than the second, strongly excised
Microstilba Förster

67. Mesonotum *with* 5 carinae . . . . Tropideucoela Ashmead
Mesonotum *without* carinae . . . . . Disorygma Förster

68. Marginal cell *open* along the front margin 69
Marginal cell *closed* along the front margin 71

69. Scutellum normal, unarmed 70
Scutellum abnormal, armed with two horns behind Diceratapsis Ashmead

70. Unknown (♀ only known) . . . . . Triplasta Kieffer
Pentaplasta Kieffer
Ectolyta Förster

71. First joint of flagellum shorter than the fourth, the latter the stouter . 72
First joint of flagellum not longer than the fourth, the following slightly and gradually increasing in length . . . . . Erisphazia Förster

72. Apex of wings entire not emarginate . . . . Psilosema Kieffer
Apex of wings emarginate . . . . . Schizosema Kieffer

73. Front wings at apex *emarginate* or *excised*; apical abscissa of the submarginal vein stout, quadrate, at the most only a little longer than thick . 74
Front wings at apex *entire*, never emarginate or excised, although sometimes shortened and truncate; apical abscissa of the submarginal vein slender, not stout, always two or more times longer than thick 79

74. Marginal cell *open* along the front margin 75
Marginal cell *closed* along the front margin . . Leptopelina Förster

75. Scutellum normal, not produced into a beak at apex 76
Scutellum abnormal, produced at apex into a beak or horn
Rhynchacis Förster

76. First joint of the flagellum not or scarcely longer than the second, rarely curved, and hardly as thick as the second 77
First joint of the flagellum a little longer than the second, stouter and usually slightly curved, the following joints cylindrical, usually three or more times longer than thick and gradually but imperceptibly increasing in length to the penultimate . . . . . Kleidotoma Westwood

77. Joints of flagellum long, cylindrical, equal in length or very nearly, and at least four times as long as thick . . . . . Tetrarhoptra Förster
Joints of flagellum differently formed 78

78. Flagellar joints 1 to 3 equal in length or very nearly, the first slightly curved, clavate, the apical joints not or rarely more than three times as long as thick
Pentacrita Förster
Flagellar joint 1 scarcely as long as the second or distinctly shorter, the following joints stouter, fully thrice as long as thick . Hexacola Förster
Unknown . . . . . Heptameris Förster

79. Wings abbreviated 80
Wings fully developed 83

80. Metapleura bare or at most very sparsely pubescent 81
Metapleura clothed with a *dense* pubescence
Marginal cell incomplete, the second abscissa of the radius wanting or very short . . . . . Glauraspidia Thomson

Marginal cell completely formed, the first abscissa of the radius shorter than the second . . . . . Apistophyza Förster

81. Wings reaching at least to the middle of the abdomen, and *with* a marginal cell 82

Wings not reaching beyond the base of the abdomen, and *without* a marginal cell

Antennae 15-jointed, the first joint of the flagellum distinctly longer than the second, excised, the following not quite twice as long as thick

Aphyoptera Förster

82. Wings shorter than the abdomen, the marginal cell closed

Agroscopa Förster

Wings as long as the abdomen, the marginal cell open along the front margin, the first abscissa of the radius longer than the second

Aphiloptera Förster

83. Antennae 13- to 15-jointed 84

Antennae 16-jointed, very long, the flagellar joints long, cylindrical

Wings glabrous, the marginal cell closed Macrocereucoila Ashmead (Type M. longicornis Ashm.)

Wings pubescent, the marginal cell closed . . Episoda Förster

84. Antennae 15-jointed 87

Antennae 13- or 14-jointed

Antennae 14-jointed 85

Antennae 13-jointed

Flagellum long, filiform, the joints long, cylindrical, the first joint only about half as long as the second; cup of scutellum large, rounded Promiomoera Ashmead, gen. nov. (Type P. filicornis Ashm.)

85. Marginal cell *closed* along the front margin 86

Marginal cell *open* along the front margin . . Idiomorpha Förster

86. Cup of scutellum large, rounded, the whole disc concave Miomoera Förster

Cup of scutellum large oval the whole disc not concave, anteriorly flat, posteriorly with a fovea . . . . . Paramiomoera Ashmead

87. Marginal cell *closed* along the front margin 88

Marginal cell *open* along the front margin 101

88. Wings pubescent, the margins fringed or ciliated 89

Wings bare, glabrous, *without* a marginal fringe

Antennae long, filiform, the joints cylindrical . Eucoila Westwood

89. First abscissa of the radius distinctly shorter than the second . . 90

First abscissa of the radius as long as the second

First joint of the flagellum distinctly shorter than the second
Hypolethria Förster

First joint of the flagellum as long or nearly as long as the second
Rhoptromeris Förster

90. Scutellum normal, or at least not ending in a spine 91
Scutellum ending in a spine . . . . . Odonteucoila Ashmead

91. First joint of the flagellum usually longer than the second, more rarely equal in length, or very slightly shorter 92
First joint of the flagellum very distinctly shorter than the second
Heptamerocera Ashmead

92. Scutellum normal, the cup not modified into a carina 93
Scutellum abnormal, the axillae acutely toothed posteriorly, the cup modified into a carina which is gradually dilated posteriorly, appearing tridentate
Trissodontaspis Ashmead

93. Head and thorax smooth and shining 94
Head and thorax not smooth and shining, but finely coriaceous; scutellum with two large foveae at base, the cup narrowed ellipzoidal, connected with a carina anteriorly; antennae long, the joints long, cylindrical, the first joint of the flagellum not longer or thicker than the second, the eighth and beyond slightly shortening . . . . . Dieucoela Ashmead

94. First joint of the flagellum not greatly elongated, thickened, or strongly curved 95
First joint of the flagellum usually greatly elongated, much thickened and curved . . . . . Aglaotoma Förster

95. Marginal cell short nearly as wide as long, the second abscissa of the radius strongly curved outwardly; cup of scutellum very large 96
Marginal cell not especially short, always much longer than wide; mesonotum without furrows 98

96. Mesonotum short, *without* furrows 97
Mesonotum *with* two fine furrows abbreviated posteriorly and two very broad lateral impressions shortened anteriorly . . . Chrestosema Förster

97. Mesonotum *with* a very delicate median carina; cup of scutellum very large oval; first joint of the flagellum not longer than the second, the joints oblong oval, about thrice as long as thick . . . . Zaeucoela Ashmead, gen. nov.
(Type Z. unicarinata Ashm.)
Mesonotum *without* a median carina; cup of scutellum large rounded, the disk flat or slightly impressed; first joint of the flagellum longer than the second (or rarely shorter and slenderer), the following joints oval or moniliform hardly longer than thick or at most only about twice as long as thick, never thrice as long as thick . . . . . Ganaspis Förster

98. Cup of scutellum normal 99
Cup of scutellum overlapping the apex of the scutellum Psichara Förster
99. First joint of the flagellum not longer than the second or only a little longer 100
First joint of the flagellum very distinctly longer than the second, the following joints from 2½ to 3 times as long as thick . Hexamerocera Kieffer
100. Flagellar joints long, cylindrical, four or more times longer than thick Pseudeucoila Ashmead
Flagellar joints at the most thrice as long as thick or even shorter Pentamerocera Ashmead
101. Marginal cell confluent with the costal cell, the apical abscissa of the submarginal vein wanting 102
Marginal cell *not* confluent with the costal cell, the apical abscissa of the submarginal vein always present 103
102. Second abscissa of the radius wanting or not extending to the costa, the marginal cell therefore open at apex . . . . . Adieris Förster
Second abscissa of the radius distinct, reaching the costa; first joint of the flagellum more than twice the length of the second: the second and following moniliform . . . . . Piezobria Förster
103. Cubitus in front wings always more or less present or distinct . . 104
Cubitus in front wings obliterated or wanting 106
104. Wings pubescent, ciliate 105
Wings bare, glabrous, not ciliate . . . . Lytosema Kieffer
105. Cup of scutellum narrowed, ellipzoidal; first joint of flagellum very long, slightly curved, as long as 2 and 3 united, joints beyond cylindrical Pilinothrix Förster
Cup of scutellum rather large oval or ovate; first joint of flagellum not longer than the second . . . . . Cothonaspis Hartig
= Trybliographa Förster
106. Cup of scutellum normal or not ending in a spine 107
Cup of scutellum abnormal, ending in a strong spine Acantheucoela Ashmead
107. Cup of scutellum not large, either ovate or ellipzoidal with a fovea posteriorly 108
Cup of scutellum large broadly oval or rounded
First joint of the flagellum subclavate at least as long as the second Diranchis Förster

108. Apical abscissa of the submarginal vein much longer than thick ? gen.[1]
Apical abscissa of the submarginal vein not or only a little longer than thick
First joint of the flagellum never much longer than the second, often equal or distinctly shorter 109
First joint of the flagellum very long, stout, usually curved and as long or nearly as long as joints 2 and 3 united . . . . ? gen.[1]
109. First joint of the flagellum about as long as the second or only a little longer, the second shorter than any of the following joints . . . . ? gen.[1]
First joint of the flagellum distinctly shorter than the second, the following cylindrical, at least thrice as long as thick . Heptamerocera Ashmead

A NEW ORYSSID FROM CHATHAM ISLANDS, BISMARCK ARCHIPELAGO.

BY WILLIAM H. ASHMEAD, A. M., ASSISTANT CURATOR, U. S. NATIONAL MUSEUM.

In a lot of parasitic Hymenoptera, sent to me by Prof. T. D. Alfken, of the Städtisches museum für natur-völker-und handelskunde, Bremen, Germany, was a single male specimen of an oryssid, collected in 1899 by Dr. Hugo H. Schauinsland, in the Chatham Islands, east of New Zealand.

It is an interesting form belonging to a genus not yet known to occur on these Islands, the only other species known from these regions being from Aru.

OPHRYNOPUS SCHAUINSLANDI, sp. nov.

♂.—Length 6.6 mm. Black, the head rugose-punctate with an aeneous black tinge, the forehead tuberculate, the face with two carinae that diverge anteriorly and are connected with a transverse carina bounding the front margin; thorax shagreened; legs wholly black, the hind tibiae serrate on outer face, armed with about 11 teeth; the first three being very minute.

The wings are hyaline, with the apical third or more of the front wings fuscous, the stigma and veins being black or brown-black.

The abdomen is as in ORYSSUS, black and shining, but with the first four or five segments above more or less shagreened and faintly, sparsely, microscopically punctate.

Type in Bremen Museum.

The species is dedicated to Dr. Hugo H. Schauinsland, the Director of the Museum.

[1] These genera probably represent males in genera at present known only from the females, and I therefore do not name them.

A CATALOGUE OF THE BEES OF CALIFORNIA.

BY T. D. A. COCKERELL, EAST LAS VEGAS, N. MEX.

In the Report of the Agricultural experiment station of the University of California for 1898–1901, recently published, Mr. Carroll Fowler gives an account of the long-tongued bees of California. This is a very useful paper, so far as it goes, and Mr. Fowler has been able to make important additions to our knowledge of California bees. Unfortunately, however, the paper was prepared in 1899, and has not been brought up to date; consequently it omits numerous species recorded since that year, and is not altogether modern in the matter of generic nomenclature. It also omits several species published before 1899, and in a good many cases the names of species are incorrectly spelled. In some cases, I am inclined to doubt the identification of the species, but unless I have actual knowledge to the contrary, I must for the present treat all published records as correct.

The list here presented includes also the short-tongued bees of California, for completeness' sake. It need hardly be said, that we know comparatively little about California bees; it is quite certain that any student who takes up this group in California will find very numerous new species. The list now offered is intended to be of service to such a student or students, as it is hoped that the publication of Mr. Fowler's paper will have created an interest in the bees.

COLLETES Latr.

americana Cr., La Jolla.
californica Prov.

PROSOPIS Fabr. (cf. Entom., 1898, p. 218.)

polifolii Ckll., Mt. Lowe.
coquillettii Ckll., Los Angeles Co.
bakeri Ckll.
ruidosensis Ckll., var.
suffusa Ckll., var.
tridentula Ckll.
mesillae Ckll., Los Angeles Co.
varifrons Cr.

HALICTUS Latr.

californicus (Prov.).
farinosus Sm.
titusi Crawf., San Diego. Allied to *H. trizonatus.*
gracilis Rob.
tegularis Rob. (belongs to *Chloralictu* Rob.).
armaticeps Cr.

SPHECODES Latr.

mandibularis Cr., San Pedro.

AGAPOSTEMON Sm.

femoratus Crawf.
californicus Crawf., San Pedro, etc.
texanus Cr., San Pedro.

ANDRENA Fabr.

knuthiana Ckll., Berkeley.
nigra Prov.
nigripes Prov.
phenax Ckll., only two submarginal cells.
foxii Ckll., only two submarginal cells.
chalybaea (Cr.), only two submarginal cells.

Diandrena is a new subgenus or genus for the blue species of California with only two submarginal cells; type *chalybaea*, described as a *Panurgus*. Here also belongs *A. foxii*, and, I think, *A. phenax*.

PARANDRENA Rob.

regularis (Cr.).
concinnula Ckll., So. Cal.
enocki Ckll., So. Cal.

HESPERAPIS Ckll.

cumorpha (Ckll.), near Los Angeles (Davidson).

HALICTOIDES Nyl.

saundersi Ckll.
mulleri Ckll.
virgatus Ckll.
davidsoni Ckll., San Gabriel Mts.

MICRANDRENA Ashm.

pacifica Ashm. (a smallish black species with a large reddish stigma; detailed description not published yet).

NOMIA Latr.

Two undescribed species from California are in the National museum, bearing MS. names by Ashmead. One is near *bakeri*; the other near *foxii* but larger, though not nearly so large as *nortoni*.

SPINOLIELLA Ashm. (cf. Ann. mag. nat. hist. Jan. 1901, p. 129).

edwardsii (Cr.).
scutellaris (Fowler).
visaliensis (Fowler).
anthidius (Fowler).
zonalis (Cr.).
cincta (Cr.).

CALLIOPSIS Sm.

californicus Cr.
obscurellus Cr.

PANURGINUS Nyl.

cressoniellus Ckll.
albitarsis (Cr.).

HYLAEOSOMA Ashm. (cf. Ann. mag. nat. hist. July, 1902, p. 42).

atriceps (Cr.).

PERDITA Sm.

claypolei Ckll., Mt. Lowe.
rhois Ckll., San Diego.
rhois reducta Ckll., San Diego.
californica (Cr.).
interrupta Cr.
trisignata Ckll.

NOMADA Fabr.

citrina Cr.
interruptella Fowler.
obliquella Fowler.
obscurella Fowler.
rivalis Cr.
suavis Cr.
rubrica Prov. (Fowler makes this a var. of *bisignata*, but Robertson has shown that *bisignata* cannot be certainly recognized).
crotchii Cr.
edwardsii Cr.
melliventris Cr.
opposita Cr.
vinnula Cr.
civilis Cr.
flavipes Prov.
erythraea Dalla Torre (*rubra* Prov.).
fragilis Cr.
vincta Say.
lepida Cr.
bisignata "Say," Fowler.
formula Viereck, San Pedro.

NEOPASITES Ashm.

fulviventris (Cr.).

EPEOLUS Latr.

compactus Cr.
nigriceps Sm.

occidentalis Cr.
superbus Prov.
californicus Cr.
faceatus Prov.

TRIEPEOLUS Rob.

concavus (Cr.).

MELECTA Latr.

californica Cr.

ZACOSMIA Ashm.

maculata (Cr.), San Pedro.

BOMBOMELECTA Patt.

edwardsii (Cr.).
separata (Cr.).
thoracica (Cr.).

STELIS Panz.

laticincta Cr.
sexmaculata Ashm.

OSMIA Panz.

californica Cr.
cobaltina Cr.
maura Cr.
quadriceps Cr.
exigua Cr.
atriventris Cr.
dubia Cr.
purpurea Cr.
lignaria Say.
nigrifrons Cr.
brevis Cr.
albiventris Cr.
rustica "Cr." Fowler (Robertson says that *rustica* is identical with *albiventris*).

MONUMETHA Cr. (genus hardly distinct from *Osmia*).

imperfecta Prov.

HERIADES Spin.

odontura Ckll., near Los Angeles.
glaucum Fowler.
albicinctum Prov., probably an *Ashmeadiella*.
semirubra Ckll., not a true *Heriades*.

ASHMEADIELLA Ckll.

californica (Ashm.), described under *Chalicodoma*.

ALCIDAMEA Cr.

uvulalis Ckll., Mojave Desert.
simplex (Cr.) (*producta* Cr.).

ANDRONICUS Cr.

hesperius Ckll., sp. nov. ♂. About 12 mm. long, black. closely punctured; wings smoky; flagellun brown beneath; tarsi with short reddish hair. Clypeus with the anterior border thickened and faintly concave; scape stout; flagellum like that of ALCIDAMEA, but not hooked at the tip; first ventral segment of abdomen produced into a backwardly directed spine at the middle of its posterior margin; seventh dorsal segment subtruncate with rounded edges. Rock Creek, Mojave Desert.

CHELOSTOMA Latr.

californicum Cr.
australe Ckll., near Los Angeles.

ANTHIDIUM Fabr.

atriventre Cr.
emarginatum Say.
maculosum Cr.
tricuspidum Prov.
collectum Huard (*compactum* Prov.).
californicum Cr.
edwardsii Cr.
palliventre Cr.
illustre Cr.
maculifrons (Sm.?), Fowler.

DIANTHIDIUM Ckll.

consimile (Ashm.).
ehrhorni (Ckll.), Mojave Desert.

MEGACHILE Latr.

occidentalis leucotricha Ckll., near Los Angeles.

fidelis Cr.
fidelis concinnula Ckll.
davidsoni Ckll., near Los Angeles.
angelarum Ckll.
vidua Sm. (*frigida* Sm.).
latimanus Say.
pugnata Say.
montivaga Cr.
brevis Say.
exilis Cr. (*studiosa* Cr.).
frugalis Cr., San Gabriel Mts., Rock Creek, Mojave Desert (Davidson), near Los Angeles (Davidson).
manifesta Cr., var. Banning, Riverside Co.
pruina Sm., Catalina Island and near Los Angeles (Davidson).

LITHURGOPSIS Fox.

apicalis (Cr.), var. opuntiae Ckll., ♂, Palm Springs, Colorado Desert (Davidson).

CERATINA Latr.

dupla Say.
tejonensis Cr.
acantha Prov.
arizonensis Ckll., Mt. Lowe.

MELISSODES Latr.

actuosa Cr.
californica Cr.
personatella Ckll., La Jolla.
lupina Cr.
nigrifrons Cr.
stretchii Cr.
olivacea Cr. ("Appears to be related to the genus *Ancyloscelis* in neuration and length of tongue; however, the ♂ has the clypeus yellow; the abdomen in both sexes is covered with a dense appressed pubescence like the male of *Eutechnia grisella*, and egg-shaped; the claws are blunt and cleft in both sexes."—H. L. Viereck, litt. 1901).
menuacha Cr.
tepida Cr.
obliqua Say.
montana Cr., San Pedro, La Jolla.

DIADASIA Patt.

bituberculata (Cr.), described under *Melissodes*. Mr. Viereck tells me it is a *Diadasia*.
nerea Fowler.
cinerea Fowler.
enavata Cr.
albovestita Prov.
tricincta Prov. (Fowler says this is *enavata*).
rinconis opuntiae Ckll., San Pedro.
friesei Ckll., So. Cal.
australis Cr., San Bernardino.

XENOGLOSSA Sm.

strenua (Cr.) (*cucurbitarum* Ckll.).
patricia angustior Ckll., Los Angeles.

PEPONAPIS Rob.

angelica Ckll. (*pruinosa* Fowler, not Say).

SYNHALONIA Patt.

edwardsii (Cr.).
californica Fowler.
albicans Prov.
albopilosa Fowler.
frater (Cr.) (*speciosa* Cr.).
acerba (Cr.).
nevadensis (Cr.) (*intrudens* Cr.).

EMPHOROPSIS Ashm.

depressus (Fowler).
miserabilis (Cr.).
floridanus (Sm.).

There is also an undescribed species which Ashmead made the type of *Melitur gopsis*.

ANTHOPHORA Latr.

edwardsii Cr.
pacifica Cr.
urbana Cr.
californica Cr.
crotchii Cr.
catalinae Ckll., Catalina I.
exigua Cr.
maculifrons Cr.
quinquefasciata Prov.
flavocincta Huard (*nigrocincta* Prov.).

curta Prov.
solitaria Rits.
porterae Ckll., Mojave Desert.

ANTHOPHORULA Ckll.

coquilletti (Ashm.).

XYLOCOPA Latr.

californica Cr.
orpifex Sm.
varipuncta Patt.
fimbriata Fabr.

CENTRIS Fabr.

hoffmanseggiae Ckll.

PSITHYRUS Lep.

californicus (Cr.).

BOMBUS Latr.

californicus Sm.
centralis Cr. (? = *flavifrons* Cr.).
proximus howardii (Cr.).
occidentalis Greene.
nigrocinctus Prov.
crotchii Cr.
morrisoni Cr.
nevadensis Cr.
fervidus Fabr.
edwardsii Cr.

APIS L.

mellifera L. (*mellifica* L.), introduced.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XL.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Lycia cognataria Guenée. The egg has been noticed by A. P. W. Cramer and there are several good descriptions of the mature larva extant, besides a poor figure, published by Lintner. The larval stages have not been before noticed. I am indebted to Mr. H. H. Lyman of Montreal for the eggs, which hatched before arrival. The larvae fed readily on maple, but are, apparently, rather general feeders.

EGG. Elliptical, roundedly and distinctly flattened above and below, ends rounded and much alike, no distinct flattening of micropylar end nor marked depression of the other end. Reticulations distinct, in longitudinal rows, forming waved ridges, the cross striae being a little weaker than the longitudinal lines. Reticulations confused at the ends, and less strongly marked. Size .6 × .4 × .3 mm. "Color bright green. Laid loose in large numbers" (Lyman).

STAGE I. Head rounded, bilobed, full, blackish over the lobes, dull sordid on clypeus and mouth; sutures of clypeus deep, well marked; width about .3 mm. Body normal, moderately robust, whitish, becoming sordid green from the food; a dull purple, broad, subdorsal band, obscurely joined intersegmentally on the abdomen and completely so on joints 10–13, separate on thorax; a broad, diffuse, dull purplish ventral band, later resolving into a series of medioventral patches. Thoracic feet black, abdominal ones dark outwardly. Tubercles black, small, normal; setae inconspicuous. Cervical shield colored like the body, undifferentiated, but anal plate and anal leg shields triangular, broadly blackish edged.

STAGE II. Head rounded bilobed, squarish, a depression at apex of clypeus; width .5 mm. Body moderately robust, normal, subventral fold rather prominent. Greenish and brown, mottled, nearly all green along the subventral fold, venter and dorsum more brown, especially about the feet. Head reddish brown, reticulate in lighter, ocelli black; feet dark. Anal feet and shield reddish, resembling the head. No plates; tubercles obsolete.

STAGE III. Head high bilobed, flat before, lobes rounded, projecting above the dorsum, pale yellowish sordid, thickly mottled with brown; width .8 mm. Body rather robust, normal, venter somewhat flattened. Pale yellowish, this color showing on subventral fold but elsewhere thickly mottled in dead leaf brown. Thoracic feet pale greenish, foot of joint 10 dark brown outwardly. Anal shield lighter brown, resembling the head. A white patch on each side of clypeus and across it more faintly.

STAGE IV. Head high bilobed, flat before, lobes subconic, projecting rather widely; brown, mottled in white before and also a little with smoky, a blackish arc at apex of clypeus; sides less strongly mottled; width 1.3 mm. Body rather short, moderately robust, normal. Smooth green, overlaid with a brown shade, most distinct at the contracted ends; joints 2–4 and 10–13 slightly shining, without defined markings, only the faintest traces of pale lines showing at the ends.

STAGE V. Head high bilobed as before, red-brown, mottled with white, which forms curved streaks on the faces of the lobes; vertex behind and sides at neck dark shaded; width 2 mm. Body cylindrical with a process on joint 9 bearing tubercle iii, rounded and cushion-like; no cervical shield, anal plate triangular, anal foot plates large, elongate, with stout anal prongs. Light red-brown to dark sordid brown, irregularly shaded, darker on the anterior halves of the segments, darkest ventrally. Feet dark at base. Setae short, stiff, black, from indistinct tubercles.

STAGE VI. Head high bilobed, flattened before, lobes forming low cones, widely separated by a broad notch; clypeus rather high; surface shagreened; wood brown, mottled and shaded with dark brown, darkest in a small patch at apex of paraclypeus; width 3.6 mm. Body cylindrical, stout, joint 2 slightly collared at the anterior edge and angled subdorsally, the angles dark and preceded by pale marks which are exposed or concealed according to the position of the larva; third pair of thoracic feet usually extended while the first two pair are appressed; a slight ventral prominence on joints 6, 7, and 8 bearing small spines; a large lateral conical prominence on joint 9 above and before the spiracle with black spines; a low rounded collared hump on joint 12, marked in pale subdorsally. Feet normal, a white subventral fringe between those of joints 10 and 12; anal plate and leg shields large, gray. Body green, more or less marked with gray and brown, sometimes mostly brown. The gray occurs in segmentary bands, darkest on joints 9 and 12, the abdominal feet gray. Dorsum brown shaded. Thoracic feet light reddish with nearly black shading at the bases. Spiracles reddish. Skin with many secondary granules, mostly white, but becoming black spines on the humps and clavate, capitate papillae in the subventral fringe of joints 10-12. Primary setae pointed, black, from small black tubercles, normal except that about five setae represent tubercle vii.

The larvae transformed to large red-brown pupae in the earth and hibernated in this stage.

NOTES ON SOME ALEYRODES FROM MASSACHUSETTS, WITH DESCRIPTIONS OF NEW SPECIES.

BY AUSTIN W. MORRILL, B. SC., MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST, MASS.

In his Contributions toward a monograph of the American Aleurodidae (U. S. dept. agric. Div. ent. Bull. Tech. ser. 8, 1900), Quaintance reports only one species of the genus ALEYRODES (=Aleurodes of some writers) as occurring in Massachusetts or even in New England, and this, the greenhouse Aleyrodes (*A. vaporariorum*), is probably not a native species. As a whole the genus appears to be most typical of the warmer climates, a large proportion of the described North American species being found in Georgia, Florida, California, and Mexico.

In New England except for the greenhouse (*A. vaporariorum*) and the strawberry (*A. packardi*) Aleyrodes, conditions do not seem favorable for their occurrence in large numbers. It is probable that the difficulty with which most species of ALEYRODES live through severe winters explains their comparative scarcity. In regard to the manner in which ALEYRODES pass the winters, Signoret in his Essai monographique sur les Aleurodes (Ann. soc. ent. France, 1868) says: "A n'importe quel état on les voit passer l'hiver: à l'état parfait dans les anfractuosités des arbres et des terres et même sous les feuilles; à l'état d'oeufs de larves ou de nymphes, sous les feuilles tombées, sous les feuilles de plantes qui les conservent, telles que le fraisier, le chélidoine, l'alaterne et les choux."

My own observations would indicate that adult ALEYRODES do not hibernate in this climate, although they are certainly able to stand a great amount of cold. The following extract from my notes on the strawberry Aleyrodes illustrates this last statement: "Nov. 11. A heavy frost last night as well as several preceding nights; adults on strawberry leaves appeared benumbed but became active again soon after being brought into a warm room."

The eggs of this species (*A. packardi*) deposited by the adults on the under surface of the leaves in the fall of 1901, began to hatch the following spring as early as March 23. From this time till April 14 many eggs hatched, but apparently all these larvae were killed by the frosts. Of the larvae that hatched later than April 14, few if any succumbed to the cold. The adults began to emerge from the pupa cases about the twentieth of May, previous to which time none were seen although a thorough search was made nearly every day. If the adults hibernated it is almost certain that they would have made their appearance before so late in the season.

These observations lead to the conclusion that, for this species at least, our winters are so cold as to destroy all stages except the egg. If those species whose food plants are deciduous also pass the winter in the egg stage, it would seem necessary, from our knowledge of the habits of the young larvae of ALEYRODES that the eggs be laid on or near the leaf buds, and even then the larvae would have but a slight chance of reaching maturity.

On the other hand the multiplication of ALEYRODES seems to be favored by parthenogenesis. I have thus far discovered this method of reproduction only in *A. vaporariorum*, but it probably occurs in many if not all other species of the genus. Correlated with this, I have found female ALEYRODES to be much more abundant than the males. Out of eighty-five adults taken at random, representing four different species, I found but twenty males to sixty-five females, and these figures probably represent about the usual proportion of the sexes in nature.

In regard to the length of life of the adult, and the number of eggs laid by each female, I can only state that in one instance a female of *A. vaporariorum* lived in the adult condition twenty-five days, and laid a few more than forty-five eggs.

I have here briefly considered only a few of the biological problems connected with this interesting group of insects. Very few observations have thus far been made in this direction and until the appearance of Quaintance's admirable paper, the group was much neglected systematically. During the summer of 1902 at Amherst, Mass., I found the five species of ALEYRODES mentioned below, but others — both known and unknown — undoubtedly occur in this region. It is the hope of the writer that this paper may lead to the recording of such by other workers in entomology.

1. ALEYRODES MORI MACULATA, subsp. nov.

PUPA CASE. Shiny black, elliptical; length, .72–.76 mm., width, .48–.54 mm. A copious white cottony fringe all around, continuous proximally, but ragged distally. "On dorsum of both mesothorax and metathorax near dorsi-meson is a pair of small brown setae; also a pair of setae near vasiform orifice and on caudal margin of case.... There is a pair of minute setae on the margin of case, one on each side near caudo-lateral region. On fourth abdominal segment on each side there is a group of from four to six minute pores. One or two pores are sometimes present on fifth segment on each side, just caudad of those on fourth." — Quaintance (*A. mori*).

ADULT. Fore wings marked with red and brownish black. Body with conspicuous blackish markings as follows: a transverse band across front of head, between bases of antennae; a more or less distinct dark spot on each side just above the eye; a roundish black spot on each side of prothorax just below the dorsum; a more or less elliptical black spot covering a nearly equal area on each side of mesothorax, in front of and below the insertion of fore wings, — these last two pairs of spots together occupying a space on each side of the body about equal in size to one of the dumb-bell shaped compound eyes; an elongated spot on dorsum of mesothorax on each side in front of insertion of fore wing — these spots are

oblique converging posteriorly; a smaller spot on each side of dorsum of metathorax posteriorly; a transverse spot on dorsum of abdomen just anterior to variform orifice; and a border along the posterior margin of the operculum. In addition to these clearly defined markings, there may be slight tinges of black elsewhere, seen soon after emergence from pupa case but later hidden by the flour-like wax secretion. When mounted in balsam the thorax appears of a deep orange yellow color with brownish markings, and the abdomen pale yellow in color with brownish markings.

In the Can. ent. vol. 31, p. 1–4, Professor Quaintance described *A. mori* from Tampa, Fla., on mulberry, and from Lake City, Fla., on *Tilia americana*, *Callicarpa americana*, *Liquidamber styraciflua*, *Ilex opaca* and less frequently on *Persia carolinensis*. The pupae and adults of *A. mori maculata* agree with Professor Quaintance's description of *A. mori* except for the color of the bodies of the adults which in the latter is bright yellow. Hundreds of adults of the former have been bred and the blackish markings described above have been found to be constant.

This subspecies seems to have a wide range of food plants and to be generally distributed in this vicinity. It has been found on *Cornus florida*, *C. sanguineus*, ash, birch, and mulberry, but was not found on *Tilia americana* or *Liquidamber styraciflua* although these trees grew in the neighborhood of the species of Cornus upon whose leaves this insect was quite abundant. CORNUS seems to be the favorite food plant, although even on that plant rarely more than one half dozen pupae are found on a single leaf.

Types of pupae and adults have been deposited at the Massachusetts agricultural college.

2. ALEYRODES FORBESII Ashmead.

A. aceris Forbes, 14th rept. Ill. state ent., p. 110. (1884.)

A. forbesii Ashmead, Bull. 45 U. S. nat. mus., p. 294. (1893.)

A. forbesii Quaintance, U. S. dept. agric. Div. ent. Bull. Tech. ser. 8, p. 15, 27. (1900.)

A single specimen of the pupa of this species was found on maple, *Acer dasycarpum*, and a few very large adult ALEYRODES which I took to be of this species were seen on near-by leaves.

3. ALEYRODES VAPORARIORUM Westw.

Gardener's Chronicle, 1856, p. 852. Signoret, Ann. soc. ent. France, Dec. 1868, p. 387. Quaintance, U. S. dept. agric. Div. ent. Bull. Tech. ser. 8, p. 16, 39 (1900). Britton, Bull. 140 Conn. exp. station (1902). Morrill, Can. ent. vol. 35, p. 25, 26 (1903).

This species is found rarely out of doors in this locality. It was observed last summer on butternut, nasturtiums, maple, tomato, and tobacco. It has a wide range of food plants in the green house, more than fifty being recorded by Britton.

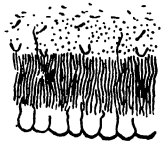
4. ALEYRODES PACKARDI Morrill.

Can. ent., vol. 35, p. 25–35. (1903.)

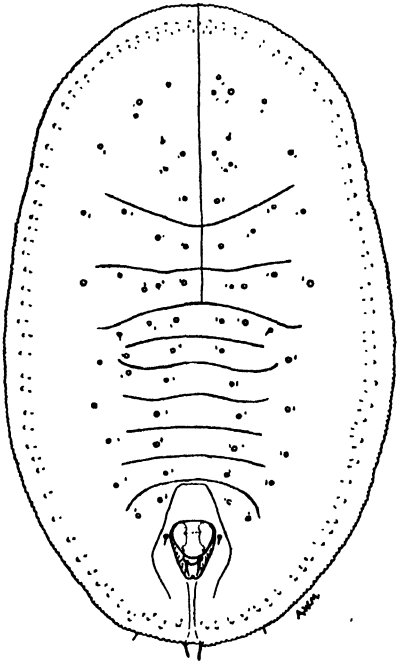
This species is very abundant on strawberries at Amherst and appears to be generally distributed throughout the Eastern United States. I have found it occasionally on Camperdowm elm, Spiraea, and ash.

5. ALEYRODES FERNALDI, sp. nov.

FULL GROWN LARVA. Length, .52 mm., greatest width, 30 mm. Form broadly elliptical. Color pale yellowish green with an irregular orange yellow body on each side in the basal abdominal region. Abdominal segmentation distinct, thoracic segmentation less so. Margin crenulated, surrounded by a narrow fringe of wax. Three pairs of marginal spines: one pair on cephalic margin, very minute; one pair on caudo-lateral region, one on each side, very minute; a pair on caudal margin, about one tenth the length of the body. Vasiform orifice essentially as in pupa. Eyes small, color dark red. In the single specimen examined but one pair of dorsal spines was observed. These were on the cephalic region between the eyes.



Aleyrodes fernaldi. Portion of margin of pupa.



Aleyrodes fernaldi. Dorsum of pupa.

PUPA. Length, .72–.84 mm., greatest width, .44–.54 mm. Form, subelliptical, slightly narrowed anteriorly; dorsal surface nearly flat; older specimens raised from surface of leaf by vertical wax fringe; margin fully crenulated. Color when freshly moulted, pale greenish white, operculum tinged with yellowish; older specimens except for a space of about one fourth the width of the body all around the margin covered with a white, thin, amorphous waxy secretion, giving to the pupae on a leaf a clear white appearance. Space between extreme margin and part covered by wax showing fine radiating striae and glistening structures which appear like rounded or conical protuberances. Across the middle of the dorsum, breaks in the waxy covering indicate the divisions between the body segments and in addition a median longitudinal break extends along the dorsum from the anterior edge of body to the base of abdomen. Wax covering or plate otherwise interrupted by rather large irregular openings through which circular pores in integument can be frequently seen, — *i. e.* one to each opening.

By dropping the pupa into xylol for a few minutes to clear and dissolve off the wax, and then mounting in xylol balsam, the surface structures can be plainly seen.

A pair of short caudal setae arise from minute papillae, barely within the caudal margin. A still smaller pair arise one on each side, a short distance from the first pair on caudo-lateral margin. Vasiform orifice subovate, one fourth longer than broad, indented posteriorly. Corrugations or folds extend downward and inward from sides of orifice. Operculum very broadly ovate, extending a little more than one half the distance toward caudal end of orifice. Lingula spatulate, setose, bearing distally three distinct side lobes on each side and a single terminal lobe. All except terminal lobe and posterior pair of side lobes covered by operculum. From each side of terminal lobe a rather stout seta arises extending caudad nearly to apex of orifice. On cephalic region about one fifth of distance from cephalic to caudal margin is a pair of spines, one on each side of middle; on first abdominal segment a second pair, one on each side; and near vasiform orifice, opposite the widest part, a third pair of spines, one on each side. These three pairs of spines are all simple, minute, and of about equal size. Extreme margin irregularly radiately striated. A short distance mesad from margin is a row, all around, of small conical projections or thickenings and mesad to these, a row of minute knobbed setae. The structures of the inner row as a rule correspond in number and position to those of the outer row. Mesad to these two rows, body loses its striated appearance and is somewhat rugose. On each side of middle of dorsum are the circular pores already mentioned. As a rule these never occur nearer the margin than a distance equal to one fifth width of body. There are about twenty-seven pairs of these, and almost invariably several unpaired ones also occur, particularly on cephalic region. Near each pore is a minute knobbed seta similar to those near margin of body. There are about fifteen or sixteen pores on cephalic region, those most anterior being usually unpaired; there are usually four pairs on mesothoracic region, four pairs on metathoracic region, two pairs on first abdominal segment, one pair on second, and two pairs each on the five following segments. On the under side of body the short and stout legs and antennae can be plainly seen. Antennae lie in pockets outside of first pair of legs, are stout, near the outer end abruptly narrowed, forming a slender tip.

ADULT ♀. Length 1.–1.2 mm. Color, pale yellow, becoming covered with white flour-like substance a short time after emerging from pupa case. Rostrum usually tipped with black. Wings immaculate, about 1.1 mm. long, and .48 mm. broad, with a single unbranched median vein; on margin are globular beads which bear on outer side several minute setae. Eyes divided into two parts; color, dark red. Legs and antennae of specimens mounted in xylol balsam nearly colorless. Segments of antennae show following proportions with eyepiece-micrometer, one-inch eyepiece, and one-half-inch obj.: 2–5–11–3–4½–4–3½.

ADULT ♂. Length .9 mm. Proportionally smaller than ♀, otherwise differing only in sexual organs.

This is a common species in this locality (Amherst, Mass.), occurring abundantly on several species of Spiraea. I have also found it though less frequently on strawberry with *Aleyrodes packardi.*

I take pleasure in naming this insect for Prof C. H. Fernald who first called my attention to its occurrence on Spiraea growing on the college grounds.

Described from a single specimen of the larva, numerous specimens of the pupae and adult females, and a single specimen of the adult male. Types have been deposited in the collection of the Massachusetts agricultural college.

A hymenopterous parasite which I bred from a pupa of this species was determined by Mr. W. H. Ashmead, of the U. S. national museum, as a male of an *Encarsia*, without much doubt the male of *Encarsia luteola* Howard; but as *luteola* was described from a female it was impossible to give the specific determination positively.

THE HEMIPTERA DESCRIBED BY PHILIP REESE UHLER. II.

BY SAMUEL HENSHAW, CAMBRIDGE, MASS.

CAPSIDAE.

DIAPHNIDIA, 46–43

debilis, 46–43 Col.: Steamboat Springs.

pellucida, 46–44. Col.: Ft. Collins; [Can.]: Quebec, near Montmorency; D. C.: near Washington.

DICYPHUS

lautus, 47–267 Japan.

minimus, 50–59 Fla.

separatus, 43–194 Mass.: Camb.; to Fla. and Tex.; Cal.; Grenada.

vestitus, 46–46 Col.: Fort Collins, Montrose; [Cal.]: Los Angeles; Dak.; N. N. Y.

DIOMMATUS, 26–32

angulatus, 46–44 Col.: Ft. Collins, Montrose.

congrex, 26–33 E. Mass.; Me.; Can.; Ill.; N. Y.: Lancaster.

ECCRITOTARSUS

elegans, 28–149 C. Tex.; Kans.: Riley Co.; Ill.; Cal.: Los Angeles.

scabrosus, 46–40 Col.: Estes Park.

ECTOPIOCERUS, 33–73

anthracinus, 33–74 Cal.: Santa Clara, near San Francisco.

EUCEROCORIS

guttulatus, 28–150 Md.: E. shore Chesapeake bay to hills of Frederick Co.; Tex.; W. Ill.

FULVIUS

lunulatus, 43–192 Grenada.

FUNDANIUS

rubens, 41–714 St. Vincent.

GLOBICEPS

angustata, 46–42 Col.: Steamboat Springs.

HADRODEMA

pulverulenta, 38–183 Ut.: near Ut. lake; Mass.: Cape Ann to S. of Boston; Ct.: near New Haven and Hartford; E. C. and W. N. Y.; N. J.: near Newark and Egg Harbor City; Pa.: near Phil., York Co.; Ill.: Galesburg, Rock Island, near Evanston; Wis.; Kans.; Col.; Md.; Va.; Geo.; N. C.; Tex.; D. C.: near Washington.

HADRONEMA, 13–412

decorata, 44–251 L. Cal.: San Luis, Calmalli mines, San José de Gracias.

militaris, 13–412 Col.; Ut.: Ogden; Cal.; (Wy.): Cheyenne.

picta, 46–31 Col.: Col. Springs, W. of Denver; Dak.

princeps, 44–251 Cal.; Or.; Wash.

robusta, 44–250 L. Cal.: San José del Cabo; Cal.: Crystal Springs, Los Angeles, San Bernardino.[1]

HEIDEMANNIA, 34–119

cixiiformis, 34–121, fig. 7 D. C.: near Washington; Md.: Oakland; W. Va.: near Ft. Pendleton.

HOPLOMACHUS

consors, 40–264 Cal.: Argus mts., vic. Los Angeles.

IDOLOCORIS

agilis, 17–425 pl. 28, f. 17 [Col.]: Beaver Brook gulch.

famelicus, 18–413 N. H.

ILNACORA

chloris, 17–419 (Sthenarops) Col.: Manitou Park, vic. Col. Springs.

viridis, 46–41 Col.: Steamboat Springs.

LABOPIDEA, 17–415

chloriza, 17–416 Ut.: Amer. Fork Canon.

LABOPS

hesperius, 13–416 Col.; Mont.; B. Amer.: vic. Lake Winnepeg and Great Bear lake.

LEPTOPTERNA

amoena, 13–409 Id.: vic. Snake river; Dak.

LOPIDEA, 13–411

marginata, 44–249 L. Cal.: San Julio; Cal.; Ariz.; Col.; E. U. S.

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[1] *Halticus minutus* Uhler ms. is figured by Popenoe, Ann. rept. exper. station Kans. state agric. college for 1889, 1890, pl. 9 f. 10–12. The name is preoccupied and *uhleri* is proposed for the species by Giard C. R. soc. biol., 1892, vol. 44, p. 81.

LOPIDEA

nigridia, 46–30 Col.: Estes Park, Steamboat Springs; N. Mex.; Ariz.

robiniae, 5–24 (Capsus) Md. = media Say (1831).

LOPUS

militaris, 43–190 Grenada.

LYGUS

annexus, 13–413 Col.

guttatipes, 46–35 Col.: Manitou.

monachus, 23–208; 24–63 Mass.: Peabody, Cape Ann; Mo.; N. H.: White mts.; Can.: near Quebec; Ill.: near Normal.

obtusus, 41–713 St. Vincent.

plagiatus, 46–35 Col.: Manitou; Ind.; Neb.; Wash.; Mackenzie river region; [Can.]: Quebec; Me.

simplus, 47–266 Japan.

vividus, 44–260 L. Cal.: Comondu; S. Cal.

MACROCOLEUS

coagulatus, 17–417 [Col.]: Clear Creek canon.

MACROTYLUS

affiguratus, 46–50 Col.: North Park, Steamboat Spring.

angularis, 44–272 Cal.; L. Cal.: San Bernardino, Cape San Lucas.

lineolatus, 44–270 Cal.; L. Cal.

regalis, 33–86 [Cal.]: vic. Los Angeles.

tristis, 33–87 Cal.: vic. Los Angeles.

verticalis, 44–272 L. Cal.: Cape San Lucas; Cal.: San Diego.

vestitus, 33–88 Cal.: near Los Angeles.

MAURODACTYLUS

angulatus, 46–53 Col.: Steamboat Springs.

consors, 46–53 Col.: Leadville.

MEGACOELUM

catulum, 44–257 L. Cal.: near Cape San Lucas; S. Tex.; Pa.: York Co.

grossum, 27–70 Md.; Pa.; Mass.; Tex.; Fla.

mundum, 27–71 E. Geo.; Fla.: near Enterprise.

pusillum, 27–71 Ariz.

MEGALOCEROEA

debilis, 13–408 Col.: Berthoud Pass; Mont.; [Wy.]: Cheyenne.

rubicunda, 13–409 Col.

MELINNA, 27–68

elongata, 44–257 L. Cal.: Cape San Lucas, Calmalli mines; Tex.; Ariz.; Cal.; Fla.

MELINNA

fasciata, 17–421 (Megacoelum) Col.: near Manitou; Tex.; Mo.; Ill.: near Rock Island; Pa.: York Co.; Md.

minuta, 41–713 St. Vincent.

modesta, 27–69 [Md.]: vic. Baltimore; Pa.; N. Y.: Lancaster, Washington Co.; E. Mass.; Can.: Grimsby; Ill.: near Rock Island.

pumila, 27–69 Md.; Ill.: near Chicago, Rock Island; Tex.: Waco; E. Mass.

MIMOCEPS, 33–83

gracilis, 33–85 Wis.; N. Y.: Buffalo; Ont.: Muskoka

insignis, 33–84 Ill.: near Chicago, Galesburg.

MIRIS

instabilis, 15–836, pl. 42 f. 9; 16–316, pl. 20, f. 27 Col.: Roaring Fork.

MYRMECOPSIS, 44–276

inflatus, 44–277 ——

NABIDEA, 18–397 = Collaria Prov. (1874)

NEOBOROPS, 46–36

vigilax, 46–36 Col.: Steamboat Springs; Ariz.

NEOBORUS

rubeculus, 46–37 Col.: Steamboat Springs; N. Ill.; Mich.

ONCOTYLUS

guttulatus, 44–269 L. Cal.: San Julio, El Rosario.

longipennis, 46–48 Col.: Gore Pass, Steamboat Springs, Rabbit Ears Pass.

puberus, 44–270 Cal.

repertus, 46–49 Col.: Steamboat Springs, W. of Ft. Collins; Cal.: Los Angeles.

sericatus, 46–49 Col.: Steamboat Springs, Colorado Springs.

ORECTODERUS, 16–319

amoenus, 16, pl. 20, f. 19; 17–426 Col.: vic. Denver; N. Mex.; Tex.; Ill.[1]

longicollis, 46–47 Col.: Steamboat Springs.

obliquus, 16–320 Col.; Mass.; Conn.; Pa.; L. Can.; Ill.; Kans.; Wash.

ORTHOPS

scutellatus, 17–420 pl. 27, f. 7 [Col.]: Clear Creek canon.

ORTHOTYLUS

viridicatus, 46–48 Col.: North Park, Dolores, Trinidad, Estes Park, Steamboat Springs, vic. Denver; N. Mex.

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[1] Mr. E. P. Van Duzee has called my attention to the following paper omitted from the list given on p. 31–34: — Report upon the Hemiptera collected during the years 1874 and 1875. Ann. rept. geog. surv. W. 100 mer. Appendix N N Ann. rept. Chief Engineers for 1877, 1877, p. 1322-1334.

Orectoderus amoenus, p. 1328, *Hebrus sobrius* p. 1330, and *Telamona pyramidata*, p. 1333 S. Cal., are described as new; the first and second of these were previously described in 17.

PAMEROCORIS, 17–424
anthocoroides, 17–425 Col.: vic. Denver; Can.: Grimsby; Md.: near Baltimore; E. Mass.
PAMILLIA, 26–31
behrensii, 26–31. [Cal.]: vic. San Francisco.
PERITROPIS, 34–121
saldaeformis, 34–122 [D. C.]: near Washington; N. Ill.: near Chicago.
PHYTOCORIS
inops, 17–413; 18–402 [Col.]: Beaver Brook gulch; E. Mass.; L. Can.; R. I.; N. J.; Tex.; Md.: vic. Baltimore.
interspersus, 46–32 Col.: Cheyenne cañon, Colorado Springs.
ramosus, 44–252 L. Cal.: Cape San Lucas; Cal.: San Bernardino, Los Angeles; Ariz.: Flagstaff.
PILOPHORUS
amoenus, 26–30 Md.
gracilis, 46–42 Col.: Colorado Springs; Md.; Va.; N. J.; Mass.
walshii, 26–30 Ill.: vic. Rock Island.
PLAGIOGNATHUS
annulatus, 41–51 Col.: Steamboat Springs; N. Ill.; C. W.; N. Engl.
fraternus, 46–51 Col.: Steamboat Springs.
obscurus, 13–418 Me.; Mass.; N. Y.; N. J.; Pa.; Ill.; Mich.; Col.; Md.
politus, 46–52 Col.: Ft. Collins; N. Y.: near Buffalo.
POECILOCAPSUS
marmoratus, 44–263 L. Cal.: San José del Cabo; Tex.; Md.
POECILOSCYTUS
diffusus, 13–415 Ut.: Ogden.
intermedius, 44–261 L. Cal.: San Quintin, El Rosario; Cal.; Ariz.
obscurus, 41–715 St. Vincent; Cuba; Hayti: Grand Anse; S. Fla.; Mex.; Jamaica; Brazil.
sericeus, 17–422 [Col.]: Colorado Springs; Quebec to S. Fla., W. into Tex. and N. Mex.; Md.: York Co.; Geo.; N. C. = basalis Reut. (1875).
PSALLUS
biguttulatus, 44–275 L. Cal: Calmalli mines, El Paraiso, Margarita island.
delicatus, 26–34 Geo.
politus, 43–195 Grenada.
RESTHENIA
confraterna, 13–411; 18–399 Col.; Wis.; Ill.; Pa.; Md.
RHINOCAPSUS, 33–81
van duzeii, 33–82 N. Y.: Coldon; Md.; Va.; N. C.; Fla.

STHENAROPS, 17–418
malina, 17–419 E. Mass.; N. Y.; Pa.; Md.; Ohio; S. Ill.; Tex.; B. Amer.; Mo.
STHENARUS
rubidus, 46–41 Col.: Colorado Springs; Ill.; N. Y.: Lancaster; Cuba; San Domingo; Tex.; Fla.
STIPHROSOMA
atrata, 44–268 L. Cal.: San Julio; Cal.: Los Angeles, near San Bernardino.
croceipes, 39–373 Cal.: Los Angeles; Ut.: Amer. Fork.
robusta, 46–45 Col.: Steamboat Springs; Tex.; Mex.
SYSTRATIOTUS
venaticus, 13–414 (Poeciloscytus) Col.; Cal.; Ill.; Mass.
TELEORHINUS, 33–74
cyaneus, 33–75 [Cal.]: Los Angeles.
TERATOCORIS
discolor, 27–68 [Mo.]: near St. Louis; [Mass.]: vic. Boston; [Col.]: near Garland.
herbaticus, 27–67 Lab.: vic. Ungava Bay, vic. Hopedale.
longicornis, 46–29 Col.: Steamboat Springs.
THYRILLUS, 44–266
brachycerus, 13–416 (Rhopalotomus) Col.: Weld Co.
pacificus, 13–415 (Rhopalotomus) Mont.; Id.: near Snake river; Cal.
TINICEPHALUS
simplex, 13–417 Col.
TROPIDOSTEPTES, 18–404
cardinalis, 18–404 Mass.: Andover; [Ill.]: Chicago; Conn.
TUPONIA
subnitida, 46–45 Col.: Steamboat Springs.
XENETUS
regalis, 33–80 Fla.; Pa.: York Co.; C. Ill.; [Md.]: vic. Baltimore; Tex.: Waco.
scutellatus, 33–81 Ill.; Mass.; N. H.; Conn.; Can.: Ontario; Md.; N. C.; Va.

CERATOCOMBIDAE.

CERATOCOMBUS
minutus, 43–196 Grenada.
CRYPTOSTEMMA
fasciatum, 43–197 Grenada.

OMMATIDES, 42–159
insignis, 42–159 St. Vincent.
ONCERODES, 42–159
robusta, 42–160 St. Vincent.
SCHIZOPTERA
capitata, 42–158 St. Vincent.
scutellata, 42–157 St. Vincent

ANTHOCORIDAE.

CARDIASTETHUS
elegans, 43–201 Grenada.
HYMENOCORIS, 38–181
formicina, 38–182 Cal.: vic. Los Angeles.
HYMENODECTES, 38–180
culicis, 38–181 S. Fla.; Cuba; Ariz.; D. C.; Ut.: vic. Great Salt lake.
LASIOCHILUS
fraternus, 43–199 Grenada.
nebulosus, 43–200 Grenada.
pictus, 42–157 St. Vincent; Grenada.
varicolor, 43–198 Grenada.

TINGITIDAE.

ACANTHOCHILA
exquisita, 31–143 Fla.: Cape Florida.
AGRAMMODES 46–56
costatus, 46–56 Col.: Estes Park.
CORYTHAICA
carinata, 43–203 Grenada.
CORYTHUCA
caelata, 44–279 S. Cal.; L. Cal.: Cape San Lucas.
hispida, 44–279 L. Cal.: San Esteban.
incurvata, 44–280 Cal.; L. Cal.; Mex.; Ariz.
GARGAPHIA
opacula, 40–263 Cal.: Argus mts.
MONANTHIA
labeculata, 40–264 Cal.: Argus mts.
PHYLLONTOCHILA
debile, 47–265 Japan.

TINGIS
marmorata, 18–415 N. C.
TYPONOTUS, 41–716
planaris, 41–716 St. Vincent.

ARADIDAE.

ANEURUS
inconstans, 10–105: 18–420 Mass.
simplex, 10–106: 18–421 N. Engl.
ARADUS
ampliatus, 16–321 Cal.
debilis, 16–322 Vanc. Island.
inornatus, 16–323 Neb.; B. Col.; Wis.; Ill.; Pa.; Md.
marginatus, 39–381 Ut.: Park City, Alta.
robustus, 10–104 ——
BRACHYRHYNCHUS
simplex, 16–323 Tex.; Ind. Terr.; Cuba; Mo.; Fla.; N. Engl.; Pa.; Ill.; Md.

PHYMATIDAE

PHYMATA
angulata, 43–204 Grenada.

NABIDAE.

ALLOEORHYNCHUS
armatus, 43–207 Grenada.
APHELONOTUS, 43–208
simplus, 43–209 Grenada.
CORISCUS
assimilis, 18–422 Can.; Me.; Md.
signatus, 43–205 Grenada.
METATROPIPHORUS
tabidus, 47–268 Japan.
VELIDIA, 43–206
berytoides, 43–207 Grenada.

PSYCHE.

A DECAD OF TEXAN FORMICIDAE.[1]

BY WILLIAM MORTON WHEELER, AUSTIN, TEX.

1. ECITON (ACAMATUS) PAUXILLUM, sp. nov.

Worker. Length 1.75–2 mm.

Mandibles with a very prominent basal tooth. Head, including mandibles, fully twice as long as broad, occipital border slightly concave, posterior angles rather sharp, sides subparallel. Eyes completely absent. Antennal scape thick, not reaching half way to the posterior angle of the head, funiculus robust, first joint nearly as long as the second and third together, joints 2–6 distinctly broader than long; joints 7–9 about as wide as long. Thorax flattened dorsally, laterally compressed, with distinct mesoëpinotal constriction; basal surface of epinotum flattened, longer than the declivity, with which it forms a rounded, obtuse angle. Petiole and postpetiole, whether seen from above or in profile, of similar size and form; each furnished with an anterior ventral tooth; petiole distinctly longer than the postpetiole, longer than broad, subelliptical from above; postpetiole not longer than broad, somewhat wider behind than in front. Gaster elongate elliptical, distinctly flattened dorso-ventrally. Legs short and robust. Claws simple.

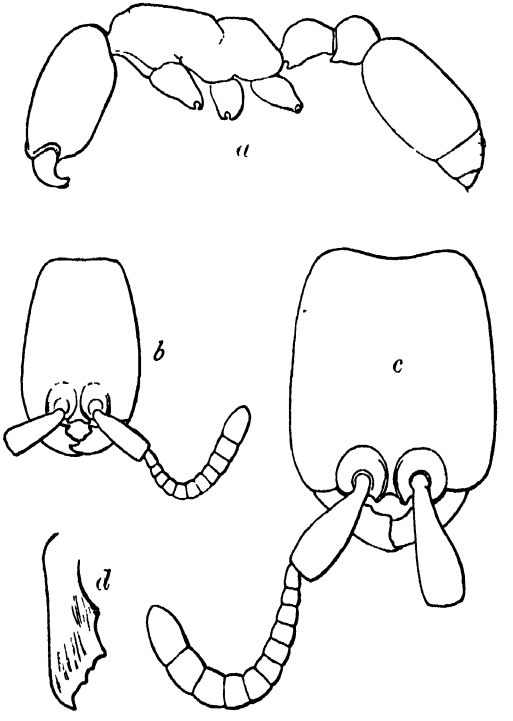


FIG. 1. *a*, Eciton pauxillum, sp. nov. Worker; *b*, head of same; *c*, head of *E. commutatum* Emery; *d*, mandible of same.

Smooth and shining, especially the head and thoracic dorsum; sides of neck, meso- and metapleurae, together with the ventral surfaces of the petiole and postpetiole, distinctly and evenly reticulate. Mandibles, head and thorax with coarse but scattered piligerous punctures.

[1] Contributions from the Zoölogical Laboratory of the University of Texas. No. 49.

Body and appendages covered with sparse and rather long, suberect, yellow hairs.

Reddish yellow throughout except the mandibles, clypeus, and anterior border of the head which are more brownish.

Described from nine specimens taken at Austin, Tex., May 25, 1901; the only occasion on which I have seen this species. The insects were moving along under a stone in a small troop, all the members of which were very nearly of the same diminutive size. The species is evidently hypogaeic in its habits like *E. coecum*, *nitens*, *commutatum*, etc.

It may be distinguished from all our North American Ecitons by its very small size, and from the species above mentioned by its very long, narrow head and the prominent, rather acute basal tooth of the mandibles. Mexican specimens which I assign to *E. commutatum* Emery have the tooth broad and blunt and the head is fully two thirds as broad as long.

2. PONERA INEXORATA, sp. nov.

Worker. Length 2.75–3.25 mm.

Mandibles long and flattened, with concavely sinuate lateral borders and about a dozen teeth, which are small and indistinct towards the base, but longer and more pointed towards the tip of the blade. Head distinctly longer than broad with concave occipital margin and subparallel sides. Clypeus broadly rounded in front, convex in the middle. Antennae rather slender, scape reaching to the posterior angle of the head, joints 2–5 of the funiculus fully as long as broad, the remaining joints longer than broad. Eyes very small, with at most 3–4 ommatidia in their longest diameter and situated about one fourth the distance from the anterior to the posterior border of the head. Thorax with very distinct promeso-notal and meso-epinotal sutures; pronotum broader than the succeeding thoracic segments, rounded, with rather sloping anterior angles; mesonotum convex; epinotum laterally compressed, its basal portion in profile horizontal and nearly straight, its declivity flattened, with rounded sides, not carinate. Petiole decidedly narrower than the first gastric segment, its anterior surface flattened dorsoventrally but distinctly convex from side to side; posterior surface flat in both directions, so that the segment when seen from above is somewhat semi-circular; seen from behind the border of the node is nearly circular in outline. Gaster of the usual form. Legs moderately stout, each tibia with a pair of spurs, one of which is pectinated.

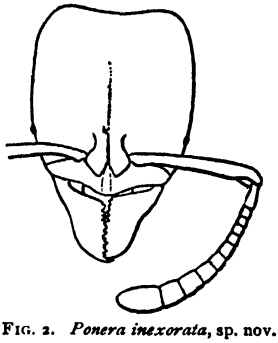


FIG. 2. *Ponera inexorata*, sp. nov. Head of worker.

Surface of the body, especially the dorsal surface of the head, thorax, and petiole, shining. Mandibles with coarse, scattered, piligerous punctures. Head covered rather densely but not confluently with coarse piligerous punctures or small foveolae. Pronotum with similar but smaller and sparser punctures; neck and mesonotum finely corrugated above; meso- and

metapleurae similarly but more coarsely sculptured, subopaque. Petiole and gaster covered with piligerous punctures like those on the pronotum.

Whole body clothed with pale yellow, reclinate or appressed hairs, among which there are longer, more scattered, suberect hairs, especially on the thorax and abdomen.

Yellowish ferruginous throughout, mandibles, antennae, and legs somewhat paler. Epinotum, mesopleurae, and posterior gastric segments sometimes more reddish or brownish. Teeth of mandibles and anterior border of clypeus blackish.

Female (deälated). Length 3.25 mm.

Very much like the worker in form and coloration. Each ocellus with a small black spot at its margin. Head distinctly more opaque than in the worker, owing to a denser aggregation of the piligerous foveolae; the node is thinner antero-posteriorly and its anterior surface is very flat or even slightly concave from side to side. Alar insertions black.

Described from two females and numerous workers taken at Austin, San Angelo, and Fort Davis. The species is not common. It occurs in colonies not exceeding a dozen individuals and usually much smaller. I have found it only on dry hill-slopes under rather small stones (limestone in central Texas, volcanic rock in the Trans-Pecos).

P. inexorata is closely related to *P. distinguenda* Emery of Venezuela, Brazil, and Paraguay, but is smaller and yellowish ferruginous in color instead of fuscous.

3. PHEIDOLE TITANIS, sp. nov.

Soldier. Length 7.25–8 mm.

Head proportionally small, hardly larger than the gaster, a little longer than broad, excluding the mandibles, subcordate, somewhat broader behind than in front, with prominent rounded posterior corners; posterior border deeply excised in the middle. A deep groove extends from this excision to the frontal area. Mandibles robust, convex, with flattened, edentulous, and nearly straight blades which terminate in two prominent apical teeth. Clypeus short, its anterior border deeply excised in the middle, feebly and sinuately concave on either side; median surface rather flat and depressed. Frontal area triangular, as long as wide. Frontal carinae long, diverging, continued backward nearly to the middle of the head. Antennae very small, scape distinctly flattened but hardly incrassated, reaching only to a little beyond the posterior orbit; funiculus slender, its joints all decidedly longer than broad, club very short and indistinctly marked off from the remainder of the funiculus. Eyes moderate, round, at about one third the distance from the anterior to the posterior border of the head.

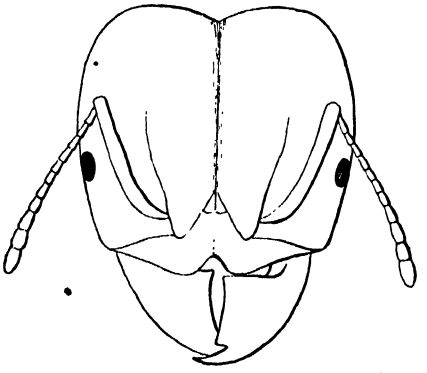


FIG. 3. *Pheidole titanis*, sp. nov. Head of soldier.

Thorax robust; pronotal angles obtusely rounded; mesoëpinotal constriction rather deep; epinotal declivity concave; spines robust, pointed, longer than broad at the base and farther apart than long; slightly curved downwards at their tips. Petiole pedunculate, seen from above constricted near the middle; in profile the dorsal surface is concave in front, convex on the anterior surface of the node, posterior declivity straight and abrupt; upper margin of node distinctly concave in the middle when seen from behind. Postpetiole transversely elliptical from above, nearly twice as broad as long and fully twice as broad as the petiole, with distinct but not very prominent lateral angles near the middle; in profile the dorsal surface is very convex, the ventral surface much more flattened. Gaster elongate elliptical, rather large. Legs long, femora conspicuously incrassated in the middle, the tibiae towards their distal ends.

Mandibles smooth and shining, with a few scattered piligerous punctures and some pronounced striae on the outer basal margin. Clypeus shining in the middle, more opaque at the sides which are coarsely longitudinally rugose. There is a prominent median ruga. Frontal area shining, with a median carinula. Head subopaque covered with rather coarse, parallel, longitudinal rugae over the anterior three quarters, posterior fourth smooth and shining, with a few scattered and shallow foveolae. Spaces between the rugae filled with minor reticulations which extend back somewhat beyond the ends of the main rugae on to the smooth occipital surface. Thorax subopaque, pro- and mesonotum more shining, pronotum and sides of mesonotum with several sharp transverse rugae. Mesopleurae and whole epinotum coarsely punctate rugulose. Petiole and postpetiole opaque, punctate rugulose throughout. Gaster hardly shining, as its surface is finely reticulate and irregularly and rather densely punctate; only the basal portions of the segments where they are overlapped by preceding segments when the gaster is not distended, are smooth and shining. Antennae and legs smooth and shining, scape, tibiae, and femora with scattered piligerous punctures.

Whole insect covered with rather long, coarse, yellow hairs, which are erect or suberect on the body, antennal scape, and legs, but shorter and less conspicuous on the funiculus and tarsi.

Rich ferruginous red, thorax and petiole somewhat darker, edges of mandibular blades, anterior border of clypeus, epinotal spines and gaster black, the posterior edges of the gastric segments yellowish, the basal half of the first gastric segment sometimes ferruginous.

Worker. Length 4–4.5 mm.

Head, excluding the mandibles, as broad as long; posterior angles rounded. Mandibles with two prominent apical teeth and the remainder of their blades finely crenulate. Clypeus short, its anterior border straight, faintly and sinuately excised in the middle, posterior median surface strongly convex. Frontal area triangular, rather indistinct. Antennae slender, scape slightly thickened distally, extending beyond the posterior corner of the head to a distance about one third of its length; funiculus with all its joints distinctly longer than broad, joints 2–7 subequal, fully twice as long as broad; club appearing 4-jointed as the 8th joint forms a transition between the basal and terminal joints. Thorax much like that of the soldier, but with less robust and narrower prothorax; epinotal spines more slender, straight and pointed. Petiole slender, more than twice as long as broad, node rounded, hardly transverse. Postpetiole as long as broad, campanulate, nearly twice as broad as the petiole. Gaster and legs of the usual shape.

Smooth and shining; mandibles, head, and gaster with sparse piligerous punctures; head in front of eyes longitudinally rugose as is also the region between and next to the

frontal carinae. Mesopleurae, epinotum, ventral and lateral surfaces of the petiole and postpetiole subopaque, reticulate punctate.

Pilosity similar to that of the soldier but less abundant.

Black or very dark reddish brown. Mandibles, anterior portion of head, pro- and mesopleurae reddish yellow. Antennae and legs reddish yellow, scape and femora darker.

Described from numerous specimens taken in the Paisano Pass, Brewster County, by myself, and in the Chisos Mts. by Judge O. W. Williams. The single nest found in the Paisano Pass was between huge immovable boulders embedded in the soil, so that I could secure only the workers, but Judge Williams obtained great numbers both of the soldiers and workers from a large nest under a stone near the foot of the Chisos.

Ph. titanis differs from all the other species of PHEIDOLE known to occur in the United States in its great size. It belongs to the group of species comprising *Ph. hyatti* Emery and *Ph. crassicornis* Emery. The soldier of *Ph. titanis* resembles the soldiers of both of these species in the relatively small size and sculpturing of the head, and the flattened antennal scape, but differs in the peculiar, short, and indistinct antennal club and the deep median excision of the anterior clypeal border.

4. PHEIDOLE TEXANA, sp. nov.

Soldier. Length 4–5 mm.

Head rather small, but larger than the gaster, a little longer than broad, excluding the mandibles, cordiform, distinctly broader behind than in front, with deeply excised posterior border, rounded posterior angles, and a rather broad median furrow extending from the frontal area to the occiput. Frontal area triangular, about as broad as long. Clypeus short, its anterior border flattened and rather deeply notched in the middle. Frontal carinae short, prominent. Eyes moderate, well in front of the middle of the sides of the head. Mandibles large, convex with flattened blades, which are finely denticulate basally, with two prominent terminal teeth. Antennal scape broadened and flattened, distinctly concave on its anterior surface, hardly reaching to half the distance between the eye and the posterior corner of the head, funiculus with all its joints longer than broad, the last three joints forming a well-developed club. Thorax not very robust, pronotal angles rounded, pronotum rather flattened above; mesonotum angular, projecting upward, concave in the middle when seen from behind; separated by a distinct suture from the pronotum and by a more distinct constriction from the epinotum. The latter has its basal surface and declivity both in the same plane, gradually sloping backwards and distinctly concave; spines well developed, blunt, longer than broad at

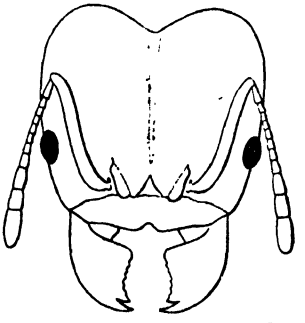


FIG 4. *Pheidole texana*, sp. nov. Head of soldier.

their bases and much farther apart than long, directed upwards, backwards, and outwards. Petiole in profile with long concave ascending nodal surface and convex ventral surface; the node is acute, transverse, with median emargination and short, concave posterior declivity; seen from above the petiole is small, not more than one and a half times as long as broad, broader behind than in front, constricted in the middle, with rather acute posterior angles. Postpetiole three times as broad as the petiole and more than twice as broad as long, with a small, acute projection in the middle on either side; in profile the dorsal surface is evenly convex and longer than the more uneven ventral surface. Gaster rather large, elliptical, flattened on its dorsal surface. Legs of moderate length and of the usual conformation.

Mandibles shining, indistinctly reticulate, covered with large piligerous punctures. Clypeus shining in the middle, faintly reticulate like the mandibles, on either side with a few coarse longitudinal rugae. Frontal area impressed, shining, with a few longitudinal rugae on either side. Head opaque throughout, covered with coarse reticulate rugae enclosing more finely reticulate interrugal spaces; the main rugae with distinctly longitudinal trend only on the front and cheeks. Cephalic furrow crossed by numerous transverse rugae especially towards the occipital border. Antennal scape shining, finely reticulate. Thorax, petiole, and postpetiole opaque like the head, but more finely reticulate rugose; only the dorsal surfaces are roughened, the pro- and mesonotum being crossed by a few coarse and irregular transverse rugae. Postpetiole with about eight shallow longitudinal impressions on its dorsal surface. Gaster and legs shining, their surfaces finely and regularly reticulate.

Body and appendages invested with rather long, more or less erect, tawny hairs.

Rich ferruginous red throughout; legs and antennae but little paler than the body; gaster somewhat infuscated posteriorly, anteriorly pellucid and in many specimens appearing as if filled with a wine-red fluid so that this region has a more brilliant color than the remainder of the body.

Worker. Length 2.5–3. mm.

Head but little longer than broad, its posterior border rather straight but not concave. Mandibles rather slender, 8-toothed, the first, second, and fourth teeth from the apex being longer than the others. Clypeus sinuately emarginate in the middle, with a median and on either side two lateral longitudinal ridges or carinulae. Frontal area triangular, as long as broad, with a median longitudinal ridge. Antennal scapes not flattened, distinctly enlarged at their distal ends; exceeding the posterior angles of the head by somewhat more than twice their transverse diameter. Pronotum rounded above and on the sides, spheroidal; mesonotum projecting upwards as a transverse ridge which is not concave in the middle when seen from behind, separated by distinct constrictions from the pro- and epinotum. The latter shaped like that of the soldier. Petiole slender, fully twice as long as broad, in other respects like the corresponding segment of the soldier. Postpetiole nearly three times as broad as the petiole, hardly twice as broad as long, its sides and dorsal surface rounded, the angles of the former being very indistinct.

Sculpture like that of the soldier but feebler, especially on the head. Pilosity and color, too, as in the soldier, except that there is a large black spot on the vertex in many specimens.

Described from numerous soldiers and workers. These were taken from four nests, the only ones I have seen during as many years. They were all situated in

different parts of Travis County, Texas, in open, sunny grass-lands. Each nest was surmounted by a regular moundlet about four inches in diameter and consisting of coarse pellets of earth. The ants are very pugnacious but their stings are feebly developed.

Ph. texana, like the preceding species, belongs to the group comprising *Ph. hyatti* and *Ph. crassicornis*, on account of the flattening of the antennal scape in the soldier, the relatively small head, etc. *Ph. texana*, however, is readily distinguished by the coarse reticulation covering the whole head and leaving no polished posterior angles, and by the antennal scape which is intermediate in length between that of *Ph. hyatti* and *Ph. crassicornis*.

5. MACROMISCHA SUBDITIVA, sp. nov.

Worker. Length 2–2.5 mm.

Head somewhat longer than broad, rounded at the posterior angles and convex above. Mandibles rather small, with three acute apical and three much smaller basal teeth. Clypeus short, broadly rounded in front, convex in the middle, with a prominent median carina running its full length and continued over the frontal area. Frontal area large, triangular, longer than broad. Antennae long, 12-jointed; scape extending beyond the posterior corner of the head to a distance equal to twice its breadth; first funicular joint nearly as long as the three succeeding joints together, joints 2–8 about as long as broad, two penultimate joints subequal, together as long as the terminal joint. Thorax short and thick-set, dorsum in profile convex, evenly rounded; prothorax with broadly rounded angles, promesonotal suture very faintly, mesoëpinotal suture somewhat more distinctly indicated. Epinotum armed with two stout spines, which are very close together at their bases but diverge strongly outward, upward, and backward; epinotal declivity concave. Petiole long, with a conspicuously elongated peduncle which passes very abruptly into the transverse node; the latter is much compressed antero-posteriorly when seen in profile, the anterior and posterior surfaces being flattened and perpendicular, the summit of the node narrow and rounded; when seen from behind, the edge of the node is horizontal and nearly straight. There is a small but distinct tooth on the ventral surface of the petiole near its anterior end. Postpetiole from above but little wider than the node of the petiole, fully twice as broad as long, rounded oblong; in profile it is nodiform, very convex dorsally, in both views showing a decided constriction at its insertion into the gaster. Gaster of the usual shape, with a long, powerful sting. Legs of the usual shape, with the femora conspicuously incrassated in the middle. There are no spurs on the middle and hind tibiae.

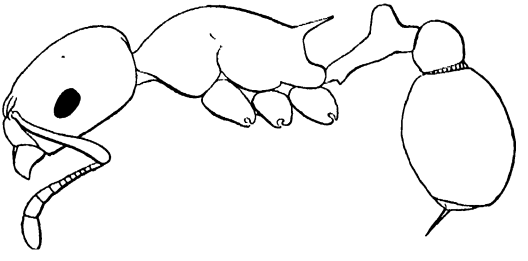


FIG. 5. *Macromischa subditiva*, sp. nov. Worker.

Head, including the mandibles and clypeus, subopaque, sharply longitudinally rugose; the rugae connected by subsidiary reticulate rugae on the base of the mandibles, cheeks, and sides of the head. Clypeus and frontal area more shining, the former with few rugae, especially near the middle. Thoracic dorsum shining, pleurae and epinotum subopaque. Whole surface of thorax reticulate rugose, regularly in the opaque regions, more irregularly and more longitudinally on the shining dorsal surface. Petiole and postpetiole shining above, reticulate and subopaque on the ventral and lateral surfaces. Gaster very smooth and shining. Legs more opaque, finely but distinctly reticulate.

Head, thorax, and abdomen beset with sparse, erect, obtuse, silvery white hairs; antennae and legs with minute, appressed, pointed hairs of the same color.

Body black or, in immature specimens, very dark brown; mandibles, antennae, legs and epinotal spines, tip of gaster, and sting yellow, scape and club of antennae, bases of epinotal spines, and greater portion of femora and tibiae infuscated.

A rare species described from a few specimens taken along Walnut Creek, near Austin (May 12, 1901), and at New Braunfels (June 3, 1901). In the former locality they were found walking on the leaves of bushes, in the latter on a dead limb lying on the ground. I did not succeed in finding the nest which is probably small and not very populous.[1]

This is the first species of MACROMISCHA to be described from the United States, and I am not altogether sure that it is to be assigned to this neotropical genus. It certainly resembles some of our species of LEPTOTHORAX with 12-jointed antennae, like *L. obturator* Wheeler. Emery maintains that MACROMISCHA differs from the other myrmicine genera in the following characters: 1. the petiole has a long peduncle; 2. the postpetiole is campanulate and attached by its whole breadth to the first gastric segment; 3. the thoracic dorsum is continuous, *i. e.*, without sutures or constrictions; and 4. there are no spurs on the middle and hind tibiae. *M. subditiva* does not present the second and third of these characters, but it certainly differs from our species of LEPTOTHORAX in the remarkable shape of the petiole.

6. ATTA (TRACHYMYRMEX) TURRIFEX, sp. nov.

Worker. Length 3–3.75 mm.

Mandibles long, pointed, 7–8 toothed. Clypeus short, with a deep excision in the middle of its anterior border. Head with pointed posterior angles, deeply excised occipital margin and rather straight, subparallel sides. Frontal carinae large, suboblong, conspicuously concave on their upper surfaces, and continued back to the posterior angles of the head as prominent crenated ridges, on either side bounding a marked concavity for the recep-

[1] Since the above was written I have succeeded in finding a single nest of *M. subditiva*. This was a small cell excavated in the bark of a huge willow (*Salix nigra*) near Austin. The cell contained about twenty workers and resembled in every way the nests of our corticolous species of LEPTOTHORAX.

tion of the antennal scape when folded back. Just behind the posterior angle of the head there is a prominent projection. Antennal scape robust, hardly extending beyond the posterior corner of the head; funiculus long, its joints all distinctly longer than broad. Pro- and mesonotum high, arched dorsally above the epinotum which is separated by a deep constriction from the mesonotum and has its basal surface of about the same length as its abrupt and somewhat concave declivity. Sides of mesonotum carinate. The thorax is armed with the following prominent spines and protuberances: pronotum with two spines on either side and a double tubercle in the mid-dorsal line: mesonotum with a large blunt tubercle at either anterior corner and farther back a pair of smaller spine-like tubercles which are much closer together than the anterior pair; epinotum with a pair of prominent spines, the bases of which are continued forward as ridges bordering the basal dorsal surface of the epinotum. These spines are longer than their distance apart at their bases, and are directed outwards, backwards, and upwards. Petiole in profile depressed, the pedicel rising gradually into the somewhat rounded node, sides subcarinate, ventral surface with a small acute tooth at the extreme anterior end; seen from above the node is oblong, distinctly longer than broad. Postpetiole nearly twice as broad as long, its anterior border rounded, its posterior border straight, with a large depression in the mid-dorsal line; the sides are distinctly carinate. Gaster somewhat oblong when seen from above, slightly flattened; in profile more pyriform, sides faintly carinate. Legs of the usual conformation.

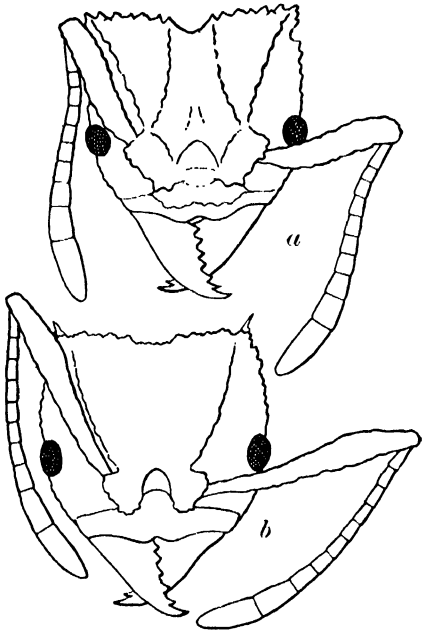


FIG. 6. *a*, *Atta* (*Trachymyrmex*) *turrifex*, sp. nov. Head of worker. *b*, *A.* (*T.*) *septentrionalis* McCook. Head of worker.

Mandibles subopaque, finely striated, the edges of the blades with a row of shallow, elongate depressions. Body, legs, and antennal scape opaque, roughened, covered with small tubercles, which are more or less connected by low confluent ridges on the head and thorax. Even the thoracic spines are covered with these tubercles. On the gaster they are very uniformly distributed. Funicular joints smooth.

Hairs rather uniformly covering the body, legs, and antennal scape, brown, short, and more or less recurved or hooked.

Rich reddish brown throughout; teeth of mandibles and dorsal surface of head between the frontal carinae, black. In old specimens the body is much darker in color and its roughened portions are overlaid with a bluish bloom which is intensified when the insect is boiled in caustic potash. Young specimens are paler yellowish brown.

Female. Length 4–4.5 mm.

Very similar to the worker in the structure of the head, pedicel, gaster, and appendages. Pronotum with a prominent tubercle on either side, mesonotum and paraptera flat, without

spines or prominent tubercles; scutellum continued back as a pair of flat, triangular projections. Spines on the epinotum very robust. Wings fully 5 mm. long; extending far beyond the tip of the gaster, yellowish white, opaque, like ground glass; veins brownish, insertions black.

I have taken this new fungus-growing ant in the following localities in Texas: Fort Stockton, Pecos County; Del Rio, and Langtry, Valverde County; Marfa, Presidio County; Marble Falls, Burnet County and in many places in the vicinity of Austin, Travis County. It is nowhere very abundant and is easily overlooked on account of its extremely retiring disposition. Its nests and mushroom gardens, which I hope to describe at length in another place, are similar to those of *Atta septentrionalis* McCook. The entrance to the nest is very often surmounted by a peculiar turret, sometimes 1¼ inches high and built of little twigs, leaves, etc.

Atta turrifex is a well-marked species. The worker differs from the worker of *A. septentrionalis* and the Mexican *A. saussurei* Forel in the following characters: The antennal scape is much shorter, hardly reaching beyond the posterior angle of the head, the lobes of the frontal carinae are broader and more concave, the posterior angles of the head are more acute, the sides of the head are straight and not rounded. The spines on the pro- and mesonotum are longer and of a different conformation, the postpetiole is conspicuously shorter, the general color of the body is darker, and there is no dorsal black band on the gaster. The characters of the head alone, as shown in the accompanying camera sketches of *A. turrifex* and *A. septentrionalis*, will suffice to separate the species at a glance. There are corresponding differences between the females of the two species.

As I have at last discovered *A. septentrionalis* in Texas (at Milano and Denton), it is clear that Buckley's name *A. tardigrada*, usually applied to this species, should be given up, since there is no way of deciding to which of the two species, his very inadequate description refers.

7. Brachymyrmex nanellus, sp. nov.

Worker. Length 1 mm.

Mandibles 5-toothed, median tooth minute. Head about as broad as long, clypeus broadly rounded in front, its anterior border with a sinuous impression on either side. Antennal scape reaching to the posterior corner of the head, funiculus rather short and thick, joints 2–6 not longer than broad. Eyes with rather large ommatidia of which there are only about six in the maximum diameter. Maxillary palpi short, the three terminal joints less than one and a half times as long as broad. Promesonotal and mesoëpinotal sutures distinct, the latter deeper, very conspicuous, and constricted. Petiole seen from behind, oblong but little higher than broad.

Whole body smooth and shining, gaster somewhat more opaque.

Clothed with delicate, appressed, yellowish hairs; on the clypeus and mandibles the hairs are longer and suberect. Each gastric segment bears on its posterior edge a row of prominent hairs.

Pale yellow, dorsal surface faintly tinged with brown; teeth and edges of mandibular blades black.

Male. Length 1 mm.

Mandibles spatulate, their rounded, edentulous blades not meeting with their tips. Clypeus short, with straight anterior border. Antennal scape slender, reaching a little beyond the posterior angle of the head, funiculus with basal joint twice as long as broad and more robust than any of the succeeding joints, joints 2 and 3 hardly longer than broad, joints 4–8 less than one and one half times as long as broad, terminal joints slender, a little shorter than the three preceding joints together. Mesonotum large, overarching the small head, so that it is not seen when the insect is viewed from above. Epinotum flattened. Petiole rather long and thick, anterior surface of node somewhat concave, posterior surface longer and like the ventral surface, convex. Outer genital appendages robust, rounded.

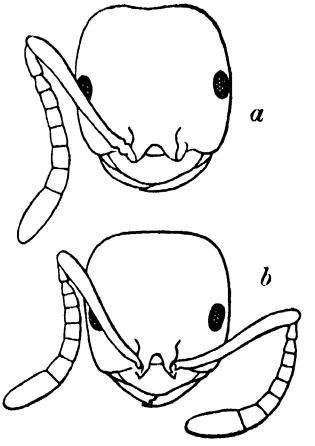


FIG. 7. *a*, *Brachymyrmex heerii* Forel. subsp. *depilis* Emery. Head of worker. *b*, *B. nanellus*, sp. nov. Head of worker.

Surface smooth and shining, gaster somewhat more opaque.

Pilosity like that of the worker. There are two widely separated, prominent bristles on the disc of the scutellum. Genital appendages fringed with prominent hairs. Wings microscopically pilose, the posterior pair especially fringed along their anal borders with rather long white hairs.

Pale yellow, head brown especially in the ocellar region. Wings and their nervures colorless.

Described from one male and a dozen workers taken under stones in a rather dry open place at Austin, May 25, 1901. The species is certainly rare in central Texas.

B. nanellus is closely related to *B. heerii* Forel subsp. *depilis* Emery, the only other member of the genus known to occur in the United States. The worker *nanellus* is distinguished by its much smaller size (*B. heerii depilis* measures 1.5–2 mm.), the shorter funicular joints and maxillary palpi, and the much paler color (*depilis* is distinctly brown). The male is also much paler in color than the male of *depilis*. It is possible that *nanellus* may have to be reduced to the rank of a subspecies of *heerii*, when the various species of the extremely difficult American genus BRACHYMYRMEX are subjected to a careful comparative study.

8. PRENOLEPIS MELANDERI, sp. nov.

Worker. Length 2–2.5 mm.

Mandibles 6-toothed, with oblique blades; third and fifth tooth from the apex distinctly smaller than the others. Clypeus convex, hardly carinate, its anterior border sinuately excised in the middle. Head, exclusive of the mandibles, about as long as wide, distinctly narrower in front than behind, occipital border feebly and sinuately excised. Antennae long, scape extending for somewhat more than a third of its length beyond the posterior corner of the head, all the joints of the funiculus distinctly longer than broad; joints 3–10 subequal. Thorax rather slender, dorsal surfaces of pro- and mesonotum somewhat flattened, the sides of the former rounded. Mesoëpinotal suture distinct but not flattened at the bottom, much narrower than the distance between the pair of metathoracic stigmata. Epinotum rounded above and on the sides, its declivity flattened or somewhat concave. Petiole small and narrow, cuneate in profile, inclined forward, its ventral surface convex, the edge of the node seen from behind rounded rather than horizontal. Gaster and legs of the usual conformation.

Body smooth and shining, legs and antennae subopaque.

Antennae and legs covered with delicate appressed, whitish pubescence; head, thorax,

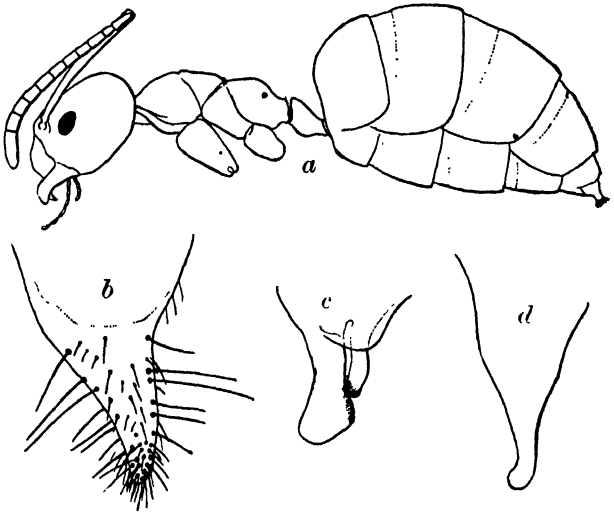


FIG. 8. *a, Prenolepis melanderi,* sp. nov. Worker. *b,* external; *c,* median, *d,* inner genital appendages of male.

and gaster with stout, erect, subobtuse hairs of a brownish or black color in certain lights, except on the posterior portion of the head where they are white. Antennal scape, femora, and tibiae also furnished with more scattered, shorter, suberect hairs.

Yellow; dorsal surface of head, thoracic dorsum, pleurae, and gaster more or less

infuscated. In many specimens the gaster and head are dark brown or black; usually in mature specimens the gaster is darker than the head, the head darker than the thorax.

Female. Length 3–4 mm.

Mandibles 6-toothed, shaped like those of the worker. Clypeus very prominent in the middle, subcarinate, its anterior border feebly excised in the middle. Head, exclusive of the mandibles and clypeus, distinctly broader than long, and narrower in front than behind. Antennae like those of the worker. Thorax broader than the head, with flattened mesonotum and scutellum. Epinotum regularly convex above, its basal surface very short, its declivity somewhat flattened but not concave. Petiole like that of the worker. Gaster of the usual shape in females of PRENOLEPIS.

Surface of body and appendages opaque, except the declivity of the epinotum which is polished and shining.

Grayish yellow pubescence covering the insect more abundant and longer than in the worker. The long hairs, corresponding to those of the worker, are relatively shorter, less obtuse and of a pale color like the pubescence.

Body dark brown, antennae, legs, lower surface and sides of head, mesonotum, and scutellum reddish. The coxae, femora, and tibiae are sometimes slightly infuscated. Wings yellowish gray, rather opaque with yellowish brown nervures and stigma.

Male. Length 1.5–2 mm.

Mandibles well developed, but edentulous. Clypeus like that of the worker but shorter and with more distinct median incisure. Head, except for the much larger eyes and the ocelli, somewhat like that of the worker in shape. Antennal scape reaching for nearly half its length beyond the posterior corner of the head. Mesonotum broad, rounded and convex in front, but depressed just in front of the very convex scutellum. Basal surface of epinotum rather long, flattened; the declivity perpendicular. Petiole thicker and blunter above than in the worker. Outer genital appendages triangular, tapering, longer than broad, a little recurved so that their anterior border is convex, the posterior concave. Median appendages bifurcated, short, the inner ramus broadly club-shaped at the apex, papillose on its external border; lateral ramus digitiform, much shorter than the inner ramus, with its end papillose. Inner genital appendages long, triangular, with a rounded knob at the somewhat recurved apex. When *in situ* the tips of these appendages may project beyond the larger external pair. Legs long and slender, wings like those of the female.

Head, thorax, and abdomen smooth and shining, the surface delicately reticulate. Antennae and legs more opaque.

Pubescence and pilosity as in the worker, except that the erect hairs on the body are relatively shorter, more tapering, and less conspicuous. The hairs on the outer genital appendages, though numerous, are not more prominent than those on the gaster.

Coloration like that of the worker except that the gaster is darker, and usually quite black; the head is dark brown, the thorax somewhat paler. Antennae and legs more or less infuscated. Outer genital appendages dark brown, median and inner pairs pale yellow. Wings colored like those of the female but with very pale and indistinct nervures.

Described from numerous specimens of all the sexual forms from the following localities: San Angelo, Tom Green County; Austin and environs, Travis County; New Braunfels, Comal County, and Fort Davis, Jeff Davis County. I have also received this species from Mr. C. H. Tyler Townsend who collected it in Mexico on the Rio Santa Maria and at Cerro del Chilicote, Chihuahua.

The species, which I take pleasure in dedicating to my former pupil, Mr. A. L. Melander, is very common in central and Trans-Pecos Texas, where it occurs under stones, usually in rather damp localities but not infrequently also on the sun-scorched limestone hills at an altitude of 1000–5000 ft. Its colonies are seen most frequently during the moister seasons of the year and like the colonies of most of our Texan Camponoti contain males and winged females during the winter and early spring months (January to April 1st).

P. melanderi can be readily distinguished from *P. parvula* Mayr in having prominent hairs on the antennal scape in the worker, and in the male by the characteristic genital appendages which are very unlike those of the male *parvula*.

The species above described may be identical with the form described by Buckley as *Formica terricola*, but as this cannot be proved with certainty, since he would be a bold man who would pretend to recognize a particular species of so difficult a genus as PRENOLEPIS among the descriptions of that author, I have decided to reject Buckley's name and redescribe the species.

9. PRENOLEPIS BRUESII, sp. nov.

Worker. Length 2.5–2.75 mm.

Mandibles 6-toothed; third and fifth tooth subequal, much smaller than the others. Clypeus very convex but not carinate in the middle, its anterior border sinuately excised. Head, excluding the mandibles, distinctly longer than broad, not narrower in front than behind, occipital margin feebly excised. Antennal scape reaching to somewhat more than a third of its length beyond the posterior corner of the head; all the funicular joints longer than broad. Thorax rather robust, pro- and mesonotum flattened above, the former broad and rounded on the sides; mesoëpinotal suture pronounced but without a flat bottom, decidedly narrower than the distance between the pair of metathoracic stigmata. Epinotum evenly rounded, its most prominent portion lower than the mesonotal surface, its declivity somewhat flattened. Petiole robust, inclined forward, convex on its ventral surface, its node rather blunt in profile, its upper border horizontal when seen from behind and with rather square corners. Gaster and legs of the usual conformation.

Very smooth and shining, legs and antennae subopaque, gaster delicately reticulate under a high magnification.

Legs and antennae clothed with fine, white, appressed pubescence; head, thorax, and gaster with erect brown hairs which are distinctly longer, more tapering, and more numerous at least on the head, antennal scape, and gaster than in *P. melanderi*.

Yellowish brown, head somewhat darker above, gaster blackish, legs and antennae yellow.

Female. Length 3.75 mm.

Resembling the female of *P. melanderi* but more robust and of a different color. The head is somewhat shining. Mouth, sides of clypeus, and mandibles pale yellow, the last with black teeth. Head, thorax, and gaster black; mesonotum, borders of the scutellum, and

insertions of wings reddish in some specimens. Antennal scape, coxæ, femora, and tibiae black, articulations of the legs, the tarsi, and funiculus yellow. The gray pubescence and the erect hairs, which are also gray, are prominent and give the whole ant a silky appearance. Wings grayish hyaline, rather opaque, with distinct gray nervures; stigma inconspicuous.

Male. Length 2.75–3 mm.

Mandibles well developed, but edentulous. Clypeus and head shaped like those of the worker except for the ocelli and the much larger eyes. Antennae long and slender, scape projecting for about half its length beyond the posterior angles of the head. Mesonotum rather narrow, convex and rounded in front, flattened in the prescutellar region. Scutellum convex. Epinotum with basal surface and declivity flattened, forming a rounded angle at

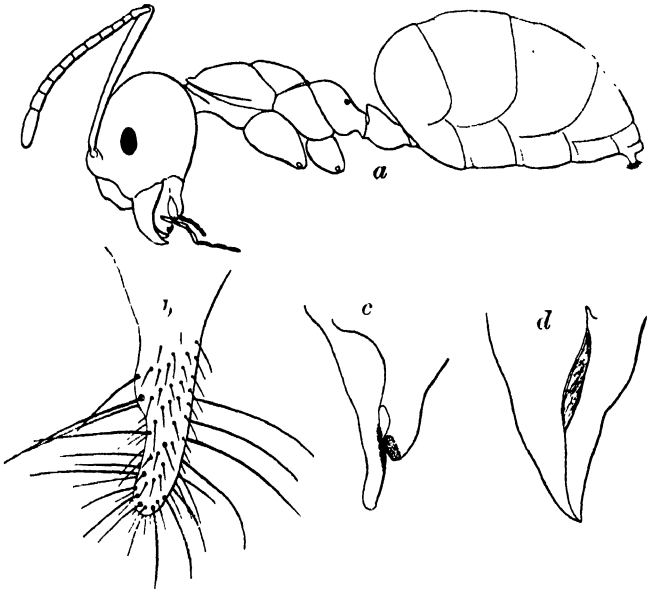


FIG. 9. *a*, *Prenolepis bruesii*, sp. nov. Worker; *b*, external, *c*, median, *d*, internal genital appendages of male.

their juncture. Petiole robust, thick antero-posteriorly, in profile broadly rounded above convex below; the summit of the node seen from behind is very slightly arcuate, nearly horizontal. Gaster long, compressed dorso-ventrally. External genital appendages very long, digitiform, rounded at the tip. Median appendages bifid; inner ramus very long and slender with its papillose surface on the side and some distance from the tip; outer ramus short, thick, somewhat curved, with an extensive papillose surface at its end. Inner genital appendages long, triangular, with a prominent longitudinal fold near the middle and a very slightly recurved point. Wings of the usual shape. Legs rather long.

Head, thorax, and gaster shining, mesonotum more opaque, being very finely and evenly punctate. Legs and antennae subopaque.

Legs and antennae clothed with fine gray pubescence, as are also the head and thorax.

The long erect hairs are distributed as in the worker, but are shorter and less conspicuous. On the outer genital appendages there are numerous erect hairs, which, however, are less robust and shorter than the hairs on the gastric segments.

Head, thorax, and abdomen deep black as are also the mandibular teeth, and the femora and tibiae except the articulations which are yellow. Mandibles, sides of clypeus, and tarsi yellow. Antennae and genital valves more or less infuscated. Wings grayish hyaline with gray nervures, more indistinct than in the female.

This species which I dedicate to my former pupil, Mr. C. T. Brues, is described from numerous males, females, and workers which I collected Dec. 19th, 1901, in Fresno Cañon, in the southern part of Presidio County, Texas. The nests, more extensive and populous than those of *P. melanderi*, were found under piles of stones, just above high water mark where the soil retains some moisture during the dry season. *P. bruesii* is sufficiently distinct from all the described American PRENOLEPIS on account of the peculiar configuration of the male genital appendages.

10. CAMPONOTUS TEXANUS, sp. nov.

Worker maxima. Length 10–12 mm.

Mandibles small, convex, 5-toothed. Head large, about as broad as long, distinctly wider behind than in front, sides moderately convex, posterior border straight when the head is viewed squarely from the front. Clypeus a little longer than broad, not keeled in the middle, its anterior border with a shallow median excision bounded on either side by a prominent tooth. Frontal area small, obscure. Frontal carinae prominent, lyrate. Front with a median groove accentuated by a longitudinal depression towards its posterior end. Cheeks rather uneven, with a deep impression or dimple at the lateral border of the clypeus. Eyes broadly elliptical, flattened. Antennal scape barely reaching the posterior corner of the head, slender and slightly flattened at the base, thicker and more cylindrical towards the distal end; funiculus slender, consisting of joints more than twice as long as wide. Thoracic dorsum regularly arcuate in profile; pro- and mesonotum somewhat flattened dorsally, the former distinctly carinate along its anterior border; pleurae, especially the meso- and metapleurae compressed and flattened; epinotum with a short, slightly concave declivity passing evenly into the rounded basal portion. Sutures, except those between the meso- and metapleurae, distinct. Petiole thick, with convex anterior and very flat posterior surfaces, which form a rather abrupt angle at the summit of the node. From behind the margin of the node is evenly arcuate, passing without angles into the lateral contours. Gaster and legs of the usual shape.

Surface of body finely shagreened, smooth and shining, especially the posterior corners of the head which are highly polished. Head covered with punctures, which are coarse and conspicuous on the mandibles, clypeus, and cheeks but smaller and sparser on the remainder of the head, and especially on the posterior angles. Vertex with eight foveolate piligerous impressions in two rows of four each. Mesonotum with a few coarse piligerous punctures near the middle of its dorsal surface. Legs rather finely punctate.

Hairs on the body suberect, yellow, not abundant. On the head they are found as a row on the anterior border of the clypeus, scattered over the front and more abundant on the lower surface of the head. Mandibles with a few short hairs. Thorax with a few scattered hairs on the pro- and mesonotum and on the epinotal angle. Petiolar node fringed with a single row of hairs. Each gastric segment with two regular transverse rows, one near the base and the other near the posterior margin. There are a few scattered long hairs on the femora and tibiae and at the tip of the antennal scape; tibiae and tarsi with more numerous and smaller appressed hairs.

Head black; mandibles, clypeus, front and lower surface suffused with blood-red. Thorax and petiole rich yellowish red, the sutures of the former black. In some specimens the anterior surface of the petiole is more or less blackened. Gaster black, posterior edges of

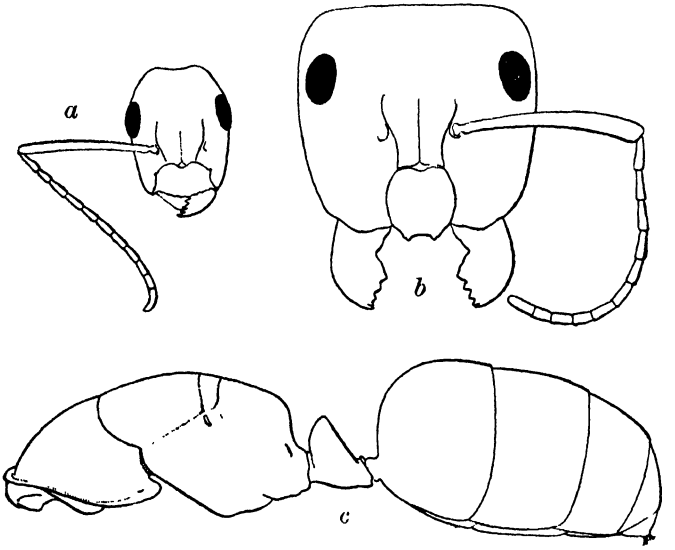


FIG. 10. *Camponotus texanus*, sp. nov. *a*, head of worker minor; *b*, head of worker maxima; *c*, body of worker maxima.

segments yellow, basal half of first segment and much of the venter rich yellowish red. Legs yellowish red, tibiae and tarsi of a somewhat deeper shade than the femora. Antennal scape, black, suffused with red, funiculus red.

Worker media. Length 9–10 mm.

Resembling the worker maxima throughout except in the smaller size and shape of the head, which is distinctly longer than wide, oblong, with subparallel sides. The blood-red color is somewhat more general on its anterior half. The antennal scapes extend to about one fourth their length beyond the posterior angles.

Worker minor. Length 8–9.5 mm. Closely resembling the maxima and media except in the size of the body and the shape and proportional size of the head, which is much longer than broad, with long, parallel cheeks, somewhat narrower posterior corners, and distinctly

concave posterior border. The five teeth of the more slender mandibles are more acute. The clypeus is subhexagonal, broader than long, and coextensive with the anterior border of the head; truncated and somewhat irregular at its anterior margin but not excised or toothed. Antennal scapes long and slender, not flattened at their bases, surpassing the posterior angles of the head by fully half their length. Eyes more narrowly elliptical and more convex than in the media and maxima. In the thorax the sutures bounding the metanotum are vague. There are no differences in color except that the antennal scapes are of a paler red.

Female. Length 12–12.5 mm.

Resembling the maxima and media, the head like the head of the latter, longer than broad, somewhat narrower in front than behind, with straight posterior border and subparallel sides. The structure of the thorax exhibits the usual sexual characters; the pronotum is prominently marginate in front, transversely convex behind, just in front of the pronounced pro-mesonotal suture. Mesonotum convex in front, flattened behind. Epinotum broad and rounded dorsally, with its declivity like that of the worker maxima. Edge of petiolar node excised in the middle.

Sculpture and coloration as in the maxima with the following differences: Mesonotum anteriorly with a large, elongate, median, black blotch and a similar blotch on either side over the parapsidal furrow. Alar insertions, scutellum, posterior borders of the paraptera, and the whole metanotum black; disc of scutellum blood-red; epinotum and pronotum slightly infuscated, the former along its sides, the latter along its posterior border. Both the anterior and posterior basal surfaces of the petiolar node more or less blackened. Wings hyaline, strongly suffused with yellow, tips more colorless; veins and stigma brownish yellow.

Male. Length 8–9 mm.

Head small, excluding the slender, edentulous mandibles, very nearly as broad as long; narrower through the cheeks, which are subparallel and slightly concave, than behind the eyes; evenly rounded posteriorly. Clypeus shaped somewhat like that of the worker minor, its anterior much broader than its posterior margin, without teeth or excision. Antennae long and slender, scape cylindrical, exceeding the posterior angle of the head by about two thirds of its length; first funicular joint slightly thicker than any of the succeeding joints. Thorax large and robust, conspicuously broad through the alar insertions, with very convex and rounded scutellum and epinotum. Petiole low, very thick antero-posteriorly, convex both on the anterior and posterior surfaces; edge of node rather blunt, in some specimens with a median excision, in others straight and horizontal. Gaster elongate elliptical, dorso-ventrally compressed. Genitalia small and slender, exserted. Legs long with prominent claws.

Body smooth and finely shagreened, but less shining than in the workers and female; mesonotum decidedly opaque. Mandibles shagreened, with a few large punctures along their outer edges. Cheeks and occiput sparsely and coarsely punctate or foveolate.

Pilosity scarse, as in the worker. Hairs on the gastric segments more scattered and irregular in their arrangement, long and prominent on the terminal segments. Antennal scape with a few long hairs at the tip.

Head black; mouth, mandibles, clypeus, and cheeks, and in some specimens also the front, yellowish red. Color of thorax as in the female, except that the three elongate black blotches on the mesonotum are more distinct. Petiole red, more or less clouded with black. Gaster black, genitalia and posterior edges of segments yellow. Wings like those of the female. Legs and antennae yellowish red.

Of this handsome species I have seen only four colonies, all taken in Travis County, Texas. Three of these were in oak logs that had been brought to Austin by the crackers from the mountain cañons northwest of the city. The remaining nest was found in Bull Creek Cañon in a crevice between two huge rocks. The males and winged females were taken in two of the nests Feb. 28, 1901, and March 25, 1902.

C. texanus appears to be closely related to *C. sayi* Emery of Arizona and Mexico. It is sufficiently distinct, however, both in size, coloration, shape of clypeus, petiole, etc.

April 15, 1903.

A NEW GENUS AND FOUR NEW SPECIES OF ASILIDAE.

BY CHARLES W. JOHNSON, BOSTON, MASS.

CERATURGOPSIS, gen. nov.

Type. — *Dasypogon cornutus* Wiedemann, Auss. Zw. Ins., I, 382, 1828.

This species has been placed by Baron Osten Sacken in the synonymy under *Ceraturgus cruciatus* Say. At the time of writing my paper on the Diptera of Florida (Proc. Acad. Nat. Sci. Phila., 1895, p. 303–304) I did not possess examples of Say's species, and as Wiedemann's species agrees quite closely in color-pattern I assumed that the synonymy was correct. Since obtaining specimens of *C. cruciatus* I was somewhat surprised to find a great difference in the antennae, so much so that *D. cornutus* cannot remain in the genus *Ceraturgus*. The antennae are so accurately described by Wiedemann, as to leave no doubt as to the species: "Erstes Fühlerglied röthlich, die folgenden schwarz: erstes und zweites von gleicher Länge; das dritte fast viermal so lang als eines von jenen, an der Spitze ein wenig verdickt; das erste der beiden Spitzenglieder sehr klein, fast verkehrt kegelförmig das letzte zusammengedrückt eirund, noch einmal so lang als das vorhergehende, mit einem sehr kurgen Seitendörnchen."

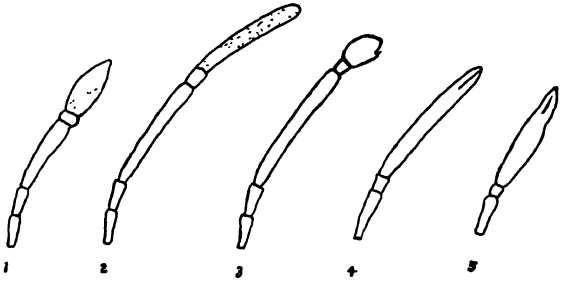
The terminal joint has a slight lobe-like projection bearing a small spine as shown in Fig. 3. In *C. cruciatus* the terminal joint is elongated and densely pubescent (Fig. 2). The rare *Ceraturgus aurulentus* Fabr., also resembles *C. cornutus*, but the form of the antennae (Fig. 1), hyaline wings, and smaller size readily separates it from that species. I have seen but three specimens of *C. aurulentus*, one taken by myself at Westville, N. J., August 21, 1892; the others

collected by Mr. E. Daecke at Castle Rock, Delaware Co., Pa., and at Lehigh Gap, Pa., July 11, by Chas. T. Greene. It is the type of the genus CERATURGUS Wied.

The specimens of *C. cornutus* were collected by Mrs. Annie T. Slosson at Ormond, Florida, in April.

DIZONIAS PILATEI, sp. nov.

The specimen (♀) on which this species is based was collected by Mr. G. R. Pilate at Tifton, Georgia, Sept. 9, 1896, and was received from Dr. Garry de N. Hough. I had placed it doubtfully with that variable species, *D. tristis* Walk. (*D. bicinctus* Loew.). After carefully comparing it with eleven specimens of that species in my collection from St. Augustine, Fla., and Opelousas, La., collected in June, I submitted the specimen to Mr. D. W. Coquillett who also considered it distinct from *D. tristis*.



1. *Ceraturgus aurulentus* Fabr. 2. *C. cruciatus* Say. 3. *Ceraturgopsis cornutus* Wied. 4. *Dizonias tristis* Walk. 5. *D. pilatei*, sp. nov.

This species is distinguished from *D. tristis* in having the thorax noticeably narrower; the third joint of the antennae (Fig. 5) shorter, proportionately broader and entirely red; the mystax finer less profuse and whitish, not red; abdominal segments one to five each bearing a broad basal band of yellow, those on the second and third occupying the entire lateral margin and gradually narrowing towards the dorsum, segments five to eight bright red, not black; wings decidedly narrower, brown, with the discal portions and margin of the veins yellowish. Length 16 mm.

It should also be noted that the great difference between the two species in their time of appearing, also shows that they are in no way related, as all data pertaining to the Asilidae indicate but one seasonal brood.

SAROPOGON BICOLOR, sp. nov.

♂. Head black, mystax and pubescence of the face yellow, antennae reddish, becoming dark brown towards the tip; proboscis black, slightly brownish at the base. Thorax black, with a large quadrate humeral spot from which extends a lateral line of the same color to the base of the scutellum, minute pustules, bearing short hairs give the entire body a punctated appearance; pleurae and scutellum black, lateral angles of the scutellum and metanotum brownish, pleurae shining. First and seventh segments of the abdomen black, the others red, with a lateral margin of black, the second segment has a narrow continuous posterior margin of black, on the others it extends but a slight distance from the lateral margin; venter black. Halters and legs reddish, coxae, tips of the posterior femora and base of the tibiae, with a very narrow ring of black, the last joint of the front and middle tarsi also black, spines on the tibiae few in numbers and mostly white, those on the tarsi numerous and black. Wings with a light brownish tinge, the veins on the basal half bright yellow; the fourth posterior cell closed and slightly petiolate. Length 12 mm.

One specimen said to have been taken near San Antonio, Texas, was given to me by the late Andrew Bolter.

SAROPOGON ABBREVIATUS, sp. nov.

♂. Similar in form to the preceding but the entire body, legs and antennae are a deep black, with the same punctated appearance; mystax for the most part black. Halteres yellow. Wings brown, the veins black, fourth posterior cell narrowly open. Length 12 mm.

Obtained with the preceding specimen and may prove to be only a variety, but with so limited material I am not justified in uniting them. The difference in the fourth posterior cell cannot be relied on even as a specific character, as it varies even in the same species. Among the four specimens of *S. adustus* in my collection, two have it closed and slightly petiolate, while in the other two it is narrowly open. The same variation exists in *S. combustus*; nor is it sexual.

Near San Antonio, Texas.

ATOMOSIA SAYII, sp. nov.

This name is applied to the variety referred to by Say under "*Laphria glabrata*" as "Var. a. Feet pale" (Journ. Acad. Nat. Sci. Phila., III, 54, 1823.)

It is very evident that Say had two species before him, and that the name and description can only apply to the one with — "feet reddish brown, the middle of the

thighs, tips of the tibia and tarsi darker." The markings on the femora really consists of a large patch of black occupying the greater portion of the upper side of the front and middle femora, and the upper side of the outer half of the posterior femora. The only specimens in my collection were taken in Fairmount Park, Philadelphia, Aug. 4, 1892, and Castle Rock, Delaware Co., Pa., Aug., 11, 1901 (E. Daecke) *Atomosia rufipes* Macquart is undoubtedly a synonym.

In *A. puella* Wied. the legs are black except a narrow ring of yellow at the base of the femora, and tibiae; antennae entirely black. The species is widely distributed, appearing in the Gulf States in May, and in the vicinity of Philadelphia late in June or early in July. *A. pusilla* Macq. can also be added to the synonymy.

In *A. sayii* the legs are pale yellow, with a minute spot at the base of the posterior femora, terminal joint of the tarsi, and claws blackish; the third joint of the antennae are noticeably longer than in either *A. glabrata* or *A. puella*; the second joint being brown. In its habits *A. sayii* differs considerably from the others. On July 23, 1893, at Folsom, Delaware Co., Pa., I captured over 75 specimens of both sexes, and invariably on the leaves and terminal shoots of plants; while *A. puella* and *A. glabrata* are as a rule found on stumps, logs, or the trunks of trees.

Its distribution is similar to *A. puella*, but appearing somewhat later: Opelousas, La., June (Pilate); in the vicinity of Philadelphia, July 23 to 31.

Atomosia soror, Bigot from Lower California, resembles *A. sayii* in having pale yellow legs; but is distinguished by the lighter colored antennae, the more abundant, prostrate, yellow hairs on the thorax and abdomen, and red post-alar protuberance.

NEW ORTHOPTERA FROM NEVADA.

BY ALBERT P. MORSE, WELLESLEY, MASS.

Among a small lot of Orthoptera collected in Nevada by Mr. C. F. Baker I find four new species, as follows: —

CORDILLACRIS AFFINIS, sp. nov.

One male, five females, Ormsby Co., Nev., July 6. These specimens agree in size, general form, proportions, and markings with *C. occipitalis*, but differ as follows: the front margin of the scutellum of the vertex is farther removed from the apex and external margin of the vertex, being nearer a line drawn at the level of the front margin of the eyes than to the apex of the vertex — in *occipitalis* the reverse is true,— and the fuscous stripe on the dorsal part of the outer face of the hind femora is broken up into narrow transverse fasciae. The name CORDILLACRIS has been proposed by Rehn (Can. ent., vol. 33, p. 271) to replace ALPHA (Brunner Rev. syst. orth., p. 121, 1893) which is preoccupied in Hymenoptera.

STENOBOTHRUS ACUTUS, sp. nov.

Five males, Ormsby Co., Nev., July 6. Closely allied to *St. curtipennis* but differing in having the vertex more produced and the angle of its sides more acute; the facial costa is also wider and scarcely or not at all narrowed opposite the median ocellus. The lateral foveolae are deep and very distinct, and the antennae average shorter (in the specimens seen). Possibly it is but a geographical race but in either case it seems worthy of a name.

Antenna: 8.5–9.5; hind fem.: 11–12; tegmina: 10–12; total length: 16–17.5 mm. The tegmina equal the abdomen.

HESPEROTETTIX NEVADENSIS, sp. nov.

Three males, three females, Ormsby Co., Nev., July 6. Very similar to *H. brevipennis*, the female somewhat smaller, differing in ornamentation and slightly in structure, the vertex being a very little narrower between the eyes, and the tegmina relatively shorter, especially in the male. The tegmina in both sexes are about one and one third times as long as the exposed portion of the abdomen (in *brevipennis* nearly or quite covering abdomen, particularly in male). General color pea-green, ranging (in male at least) to rusty brown, and varied with pale yellow stripes on mid-carina and on anterior portion of lateral carinae of pronotum, on meso- and metapleura, lower margin of genae, lower margin of outer face of hind femora, and on the veins of the tegmina especially the posterior ulnar. Hind femora with ferruginous annulus above knee, in brown male showing indications of two obliquely transverse fuscous fasciae. Hind tibiae bluish green, paler

at tip. Fuscous markings and cloudings are also present in varying degree on the lateral lobes of the pronotum and along the margins of the median dorsal pale stripe, on the vertex and occiput, the meso- and metapleura, and the geniculations of the hind femora. The anterior and middle femora are ferruginous.

Antenna: ♂, 7; ♀, 7; hind fem.: ♂, 9; ♀, 11.5–12.5; tegmina: ♂, 6.3–6.7; ♀, 8.5–9; total length: ♂, 16; ♀, 21 mm.

BRADYNOTES COMPACTA, sp. nov.

Four males, four females, Ormsby Co., Nev., July 6.

Nearly allied to *B. obesa*, differing from that species in its smaller size, the structure of the pronotum, the less upturned end of the abdomen, and in the form of the supra-anal plate of the male. In *obesa* this plate is as wide as long, in *compacta* it is distinctly longer than wide. The lateral carinae of the pronotum are equally as distinct or even better developed than in *obesa* and less irregular in course, in *obesa* being broken or angulate at the anterior and middle sulci, forming two pairs of lines diverging posteriorly while in *compacta* they form essentially but one pair of divergent lines though somewhat sinuous (♀) or subangulate (♂) at the crossing of the sulci.

Antenna: ♂, 7; ♀, 7; hind fem.: ♂, 10–10.6; ♀, 10.5–11–5; pronotum: ♂, 3.7–4.2; ♀, 4.2–4.5; total length: ♂, 18–19.5; ♀, 20–25 mm.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLI.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Erannis tiliaria Harris. This well-known larva has been frequently referred to in economic entomological literature, but I find no description of all the stages. Harris gives a good general account of the habits; Jaeger, Coquillett, Saunders, Fernald and Lugger have also written on it. The species has been bred at the Department of Agriculture and all the larval stages preserved and Mr. H. D. Merrick has sent me eggs from New Brighton, Penn., laid Oct. 31, which hatched April 6, the following year.

EGG. Elliptical, flattened on two sides, soft-shelled, concave; no flattening on micropylar end but the other end smaller and depressed; outline nearly regularly elliptical. Reticulations large and coarse, a little transversely elongate, the areas concave. Size .6 × .5 × .3 mm. Color ocherous yellow, dark gray just before hatching.

STAGE I. Head rounded, scarcely bilobed, dull, sordid, reddish luteous, held obliquely erect, vertex dark, eye dull black; width .3 mm. Body rather robust, uniform, ends rounded,

normal, no plates. Dorsum broadly sordid olivaceous with an irregular, geminate, yellowish dorsal line. Subventral region broadly pale yellow, venter sordid olivaceous. Feet slightly sordid; tubercles concolorous, obscure; setae small.

STAGE II. Head rounded, scarcely bilobed, erect; reddish luteous, sutures depressed; width .55 mm. Body normal, tubercles obscure, concolorous; dull reddish brown, the dorsum with traces of several irregular pale lines; stigmatal region broadly pale yellow, narrow on thorax. Venter dark except medio-ventrally with several irregular pale lines; feet and anal shield pale.

STAGE III. Head rounded, not notched, clypeus moderate; pale yellowish, slightly mottled, sutures of clypeus dark; width .85 mm. Dorsum broadly blackish brown with three pairs of fine irregular pale lines, of which the addorsal is the most distinct. Cervical shield and anal plate yellowish, the former divided. Stigmatal region narrowly on the thorax, broadly on the abdomen white, venter pale, all its dark marks obsolete; feet pale.

STAGE IV. Essentially as before throughout. Width of head 1.1 mm.

STAGE V. Head rounded, squarish, erect; dark red brown, uniformly irregularly reticulate with pale yellowish; width 1.7 mm. Dorsal space broadly red-brown, geminate dorsal and subdorsal brown lines on a pale field, waved; a similar, geminate, waved lateral black line on a nearly white ground, shading to brown on the anal plate; subventral ground color yellow, reddish marked behind the spiracle, faintly brown lined ventrally. (Stage V from a larva from Colorado.)

STAGE VI. Head rounded, normal, the clypeus large; rough, not shining, brownish red, pale in the sutures and around the mouth, jaws and ocelli dark; width 2.5 to 2.9 mm. Abdominal feet on joints 10 and 13, normal, the last pair large. Tubercles normal, iv stigmatal posteriorly, vi of two setae well separated, vii of three remote setae. Double dorsal and narrow, lateral black lines, crinkled, linear; a single faint addorsal; a distinct straight upper stigmatal, festooned upward anteriorly of the spiracle to touch the lower lateral. All are absent on the reddish cervical shield and anal plate. Venter and legs milky white, stigmatal region yellow, dorsal and lateral region shaded in with tan color or reddish brown of darker or lighter shades. Spiracles black rimmed. (Stage VI described from larvae from northern New York.)

Harris says the larvae prefer the lime tree, and I have found them on this plant in Plattsburgh, New York. In Colorado they were on wild cherry in the Platte Canyon.

STUDIES FOR STUDENTS.— III. ELEMENTARY STUDIES IN INSECT HISTOLOGY.

BY VERNON L. KELLOGG, STANFORD UNIVERSITY, CALIFORNIA.

For the study of the anatomy, or histology, of insect tissues, the laboratory or working room must have a certain minimum of equipment and the student a certain elementary training in histologic method or technic. By the technic of insect histology is meant the particular methods of killing, fixing, hardening, clearing, infiltrating and imbedding, sectioning, staining, and mounting, so that the various body tissues may be available for examination and study under considerable microscopic magnification. With the methods of manipulation acquired by instruction and experience, the actual study of the histologic characteristics of the various particular tissues and organs of the insect body can be undertaken. The tissues should be studied first, for almost any organ comprises in its intimate make-up several distinct tissues or kinds of cellular aggregates. In this paper I purpose giving, first, a brief account of a generally applicable course of procedure in preparing insect tissues for histologic study, and then a series of brief directions and hints for the recognition and study of the various typical or normal insect tissues, and finally similar directions and suggestions for the study of the fine anatomy of the principal insect body-organs.

As in Studies I (PSYCHE, vol. 9, p. 207) on insect anatomy and Studies II (*Loc. cit.*, p. 246) on the development of the histoblasts of wings and legs, the giant crane-fly *Holorusia rubiginosa* was used for specific subject, the same insect species will be used as principal subject of this paper. But it is plain, that the similar study of any other insect may be based on the study here outlined of this particular one.

HISTOLOGIC TECHNIC. *Killing and fixing.* — The chitinized cuticula of the insect body is nearly impervious to fixing fluids, so that for quick killing and fixing of the tissues, heat is, in most cases, the best killing agent. Tissues that have been dissected out from the body of a live (chloroformed) specimen may be fixed without heat in any of the usual fluids. To kill and fix the whole body of insects, drop specimens alive into boiling water; leave them in this but a moment or two, *i. e.*, until the body is rigid, then transfer to 30% alcohol. While here puncture the body wall with a needle, scalpel, or fine scissors in several places, not cutting deeply nor making the wound in the dorso-ventral median longitudinal plane of the body. Leave in 30% alcohol three hours; then transfer to 50% alcohol for three hours, then to 75% alcohol for from six to twelve hours, then to 85% alcohol

in which the specimens may be preserved indefinitely. Or, transfer the specimens from the boiling water to a warm concentrated solution of corrosive sublimate in 35% alcohol for three hours (puncturing the body wall just before removing to this solution); then wash in 75% alcohol; then transfer to 75% alcohol to which a few drops of tincture of iodine has been added, to extract the corrosive sublimate, then wash in clear 75% alcohol and transfer to 85% alcohol for keeping. Do not use metal instruments in handling material fixed in corrosive sublimate. Put specimens in at least ten times their own bulk of the various solutions used. Keep in corked shell vials or large homeo vials.

For more detailed account of killing and fixing methods for insects, with reference to other fixing agents and special cases, see Comstock and Kellogg's Elements of insect anatomy, chap. VIII (p. 121–139), 1901; for exhaustive account of many killing and fixing agents (for miscellaneous animals) see Lee's Microtomists' vade-mecum. Also see these two references for more detailed consideration of the subjects of the following paragraphs.

Hardening, dehydrating, and clearing.— When ready to carry material further, select from the stock of properly killed and fixed specimens (preserved in 85% alcohol) the particular specimens desired to study and transfer to 95% alcohol for from 12 to 24 hours; then to absolute alcohol for from 12 to 24 hours; then to a half-and-half mixture of absolute alcohol and cedar-wood oil (or xylol). Pour the oil slowly into the vial containing the specimens in absolute alcohol; the oil and alcohol will remain distinct at first, the specimens keeping in the alcohol; as the two liquids gradually mix the specimens will become gradually (and hence safely) infiltrated with the new mixture. Leave in this mixture for from 12 to 24 hours. Transfer to pure cedar-wood oil (or xylol); leave from 12 to 24 hours. The specimens are now ready to be infiltrated with and imbedded in paraffine preparatory to cutting by the microtome.

Infiltrating and imbedding.— Remove specimens from pure cedar-wood oil, in which they may remain without injury indefinitely if for any reason the work must be interrupted, into cedar-wood oil into which about half the same bulk of paraffine shavings have been dropped and allowed to dissolve. This mixture should be kept in a watch glass or small dish at a temperature of about 45° C. To do this keep the dish in the paraffine oven or at the back end of an imbedding triangle. (Paraffine oven or imbedding triangle may be obtained of dealers in microscopic supplies.) Remove specimens from mixture of paraffine and cedar-wood oil after from three to six hours, depending on size and thickness of body wall of specimens, to melted pure paraffine of 54° C. melting point. This paraffine must be kept melted in paraffine oven or on imbedding triangle. The temperature should not be allowed to go up much higher than the melting point of the paraffine and never to fall below it

until the infiltrating is complete. This infiltration with pure paraffine will require from three to twelve hours, depending upon the size of specimens, and character of body wall. If it is necessary to interrupt the infiltration, the specimens in the melted paraffine should not be allowed to cool slowly but the paraffine should be hardened quickly by placing the paraffine dish on the surface of cold water and plunging it beneath the surface as soon as a firm film forms over the top of the paraffine. The paraffine can later be gradually melted and the infiltration proceeded with. When ready to imbed, pour some melted paraffine into a small paper boat or into a watch glass and transfer the specimens into this boat or watch glass, orienting them with a warm needle. Cool the paraffine quickly by putting boat or watch glass into cold water. (Do not plunge beneath surface of water until film forms on top of paraffine.) After cooling the paraffine, remove paper from around the block, or cut the block out from the watch glass, and wrap up in paper or put in a vial properly labeled. The specimens in these blocks may be kept indefinitely.

Cutting.— The work of cutting sections with a microtome must be learned by observation and experience. The many kinds of microtomes make any general description of the process impossible. For cutting insect tissues, where the whole body is sectioned or where any part of the body wall has to be cut, a heavy and rigid microtome is necessary. The light, swift, wheel microtomes are not the best for such work. I have found the large, heavy machine known as Minot's New Automatic Microtome, with large knife rigidly fastened at both ends, the best instrument, of several tried, for work with insects. The fixed knife and sliding object-carrier automatically raised make possible the ribboning of sections, while the horizontal position of the knife and the arrangement for the adjustment by hand of the block for each cut make it possible to pay that special attention to each section necessary in particular cases. With this microtome I have made complete series of such heavily chitinized specimens as the pupae of blepharocerid flies or the heads of various adult insects. With hard paraffine and a rigid powerful microtome strongly chitinized insect cuticle can be successfully cut without distorting or tearing the soft tissues lying next to it. For the study of the histolytic and histogenetic phenomena in the pupae of insects with complete metamorphosis it is necessary to make uninterrupted series of complete body sections including the heavy pupal cuticle. Hence the necessity of having in the entomological laboratory a microtome capable of such strenuous work.

The sections as cut may be transferred by brush or forceps or needle to a sheet of paper until the cutting is finished, or may be put directly on the slide. The slide should be well cleaned and dried and then smeared over with (almost) the thinest possible coating of Mayer's albumen fixative. Arrange the sections in regular order in lines transverse or longitudinal to the slide, and when it is

covered (leaving always 1 sq. in. at one end for the label, to be put on later) gently flow enough distilled water from a pipette over it to float up all of the sections. Put the slide in a *safe* place to allow the water gradually to evaporate and the sections to dry thoroughly: they will, presumably, have spread out and dried perfectly flat and unfolded against the thinly smeared surface of the slide. Now gently heat the slide over a small flame until the paraffine of the sections has melted and thus further flattened and settled the sections against the glass surface. Let the paraffine harden, and put the slide into a small glass jar of pure xylol.

Clearing, staining, and mounting.— The xylol will dissolve away the paraffine in and enclosing the sections; leave slide in xylol for at least fifteen minutes; even a longer time is better. Then transfer to absolute alcohol for fifteen minutes to remove the xylol; then to 95% alcohol for from five to ten minutes; then to 75% alcohol for five minutes; then to 50% alcohol for five minutes; then into the alcoholic staining solution. There is a host of stains, some simple, some complex, some for general use, some for very particular and limited use. The beginner wants a simple stain for general use; and if he can get it in alcoholic solution, acidulated, he is relieved from carrying his slide through three or four more little jars containing, variously, water and acidulated alcohol. Transferring the slides through the alcohol series of lessening strength is simply to prevent the dangerously violent diffusion currents which are set up when an object saturated in strong alcohol is brought directly into weak alcohol. And if a stain in aqueous solution is used the series has obviously to be a longer one. For the beginner I recommend the use of Ehrlich's acid haematoxylin as a thoroughly satisfactory general stain. It is strong, staining quickly; it is an alcoholic solution, saving running the slides down to water; it is acidulated saving the differentiating bath in acid alcohol. It is cheap, and is a sharp, clean, pleasantly colored stain.

Leave slide in this stain from two to five minutes; only experience will determine the actual time for each slide. Wash slide in 50% alcohol; transfer to 75% alcohol for ten minutes; then to 85% alcohol for five minutes; then to 95% alcohol for five minutes; then to absolute alcohol for ten minutes; then to xylol for ten minutes. With thin balsam ready, remove the slide from xylol and put three or four drops of the balsam on it, and carefully but quickly, so as to prevent drying of any part of the slide by evaporation of the xylol, put the long cover-glass on in such way as to drive out all air-bubbles. Keep slide gently heated in paraffine oven or on top of imbedding triangle for half a day so as to harden the balsam; label and tuck away.

Keep the xylol, alcohol, and stain in little cylindrical staining jars or shell vials 3½ in. high by 1½ or 2 in. in diameter with class tops ground on, or good corks. Have a double series of alcohol jars, one set for the slide in its passage

(descent) from the paraffine-removing xylol down to the stain, and the other for the passage (ascent) from stain to the final xylol for clearing and preparing for the balsam mounting.

A host of changes can be rung on this simple, general procedure of clearing, staining, and mounting; but the beginner had better close his ears to these tunes and his eyes to the fascinating pages of Lee's Vade-mecum and similar guides wherein a dozen score of rainbow stains are described, and such refinements of manipulation set forth as would take a decade to learn and would make not a naturalist, but a microscopist. We need to know the technic of histology only in so far as it is necessary to know it, only in so far as we can use it, and only as a means to an end: the end being the study of insect tissue, not that of the behavior of triple stains.

THE HEMIPTERA DESCRIBED BY PHILIP REESE UHLER. III.

BY SAMUEL HENSHAW, CAMBRIDGE, MASS.

REDUIVIDAE.

ACANTHODESMA, 47–271
perarmata, 47–271 Japan.
APIOMERUS
repletus, 16–329 Cal.
CONORHINUS
maximus, 44–286 L. Cal.
protractus, 44–284 Cal.: San Diego; L. Cal.: Santa Cruz?.
rubidus, 44–285 L. Cal.: Cape San Lucas.
HARPACTOR
ornatus, 47–269 Japan.
ONCEROTRACHELUS
conformis, 43–211 Grenada.
ORTHOMETROPS, 52–508
decorata, 52–509 Md.: near Bladensburg; Pa.; N. J.: near Madison.
PINDUS
socius, 13–420 Id.: Snake river; Kans.; Dak.; Ariz.
PRIONIDUS, 21–23 = Arilus Hahn (1831).

PROCERATES, 47–270
rubida, 47–270 Japan.
PTILOCERUS
immitis, 47–269 Japan.
SAICA
annulipes, 43–210 Grenada.
SINEA
undulata, 44–282 S. Cal.; L. Cal: San José del Cabo, Calmalli mines.
VELINUS
nodipes, 1–230 (Harpactor) Japan: Simoda

EMESIDAE.

BARCE
simplicipes, 18–430 (Emesodema) Mass.: Salem.
EMESA
angulata, 41–717 St. Vincent; vic. Panama.
marcida, 47–273 Japan.
EMESOPSIS, 41–718
nubilus, 41–718 St. Vincent; Cuba.
ORTHUNGA
bivittata, 47–272 Japan.

HYDROBATIDAE.

HYGROTRECHUS
conformis, 18–435 [Mass.]: Charles river.
robustus, 11–105 Cal.: Clear Lake.
HYMENOBATES, 43–214
imitator, 43–214 Grenada.
LIMNOTRECHUS
elongatus, 47–273 Japan
METROBATES, 10–108
hesperius, 10–109 ——
PTILOMERA
tigrina, 1–230 China: Hong Kong.

VELLIDAE.

HEBRUS

concinnus, 43–221 Grenada; Atlantic States; W. I.; Cal.; Wash.; Md.

consolidus, 43–222 Grenada.

sobrinus, 17–452 [Col.]: w. of Denver.[1]

MACROVELIA, 13–422

hornii, 13–422 N. Mex.: Ft. Defiance; Cal.; Ariz.

MESOVELIA

amoena, 43–218 Grenada.

bisignata, 21–274, f. 324 Mass. S. through Fla. to Tex.; Cuba; San Domingo.

MICROVELIA

longipes, 43–219 Grenada.

marginata, 41–719 St. Vincent.

modesta, 43–220 Grenada.

robusta, 43–219 Grenada.

signata, 44–288 L. Cal.: San Esteban.

RHAGOVELIA

angustipes, 43–215 Grenada

elegans, 43–216 Grenada

obesa, 10–107 Md.: near Baltimore; E. Mass.

plumbea, 43–217 Fla. Keys; Grenada; St. Vincent.

SALDIDAE.

SALDA

anthracina, 17–438 Pa.: York Co.

coriacea, 13–421 Ut.: Ogden; N. Engl.; B. Amer.; Ill.

crassicornis, 17–438 Vic. of Saskatchewan river.

deplanata, 17–442 Me.; Mass.: Brighton, Cambridgeport; N. Y.; Md.; Tex.; N. Mex.; Mo.; Ill.; Mich.; Minn.; Mackenzie river region; Can.; near Saskatchewan river; Ont.

dispersa, 39–383 Ut.: Salt Lake; Col.: w. of Denver.

elongata, 17–448 B. Col.

explanata, 39–383: 40–265 Ut.: City Cañon, Ogden, Alton.

orbiculata, 17–450 E. Mass.; Pa.; N. Y.; Ill.; Tex.; Cal.; Calaveras, San Diego.

[1] See Note, p. 88.

pellita, 17–433 Mass.: near Chelsea, vic. Newtonville.
polita, 17–411 Cal.: San Diego.
reperta, 17–447 Mass.: Cambridge.
separata, 18–432 C. W.; N. H.; Mass.; Pa.
sphacelata, 17–434 Mass.: Newtonville, Chelsea, Lynn, Braintree; Md.: Sinepuxent Beach; Cuba; Cal.; San Diego.

GALGULIDAE.

PELOGONUS
americanus, 16–335 Tex.; Ill.; Mass.: *near Dedham; Pa.: York Co.;* Cuba.

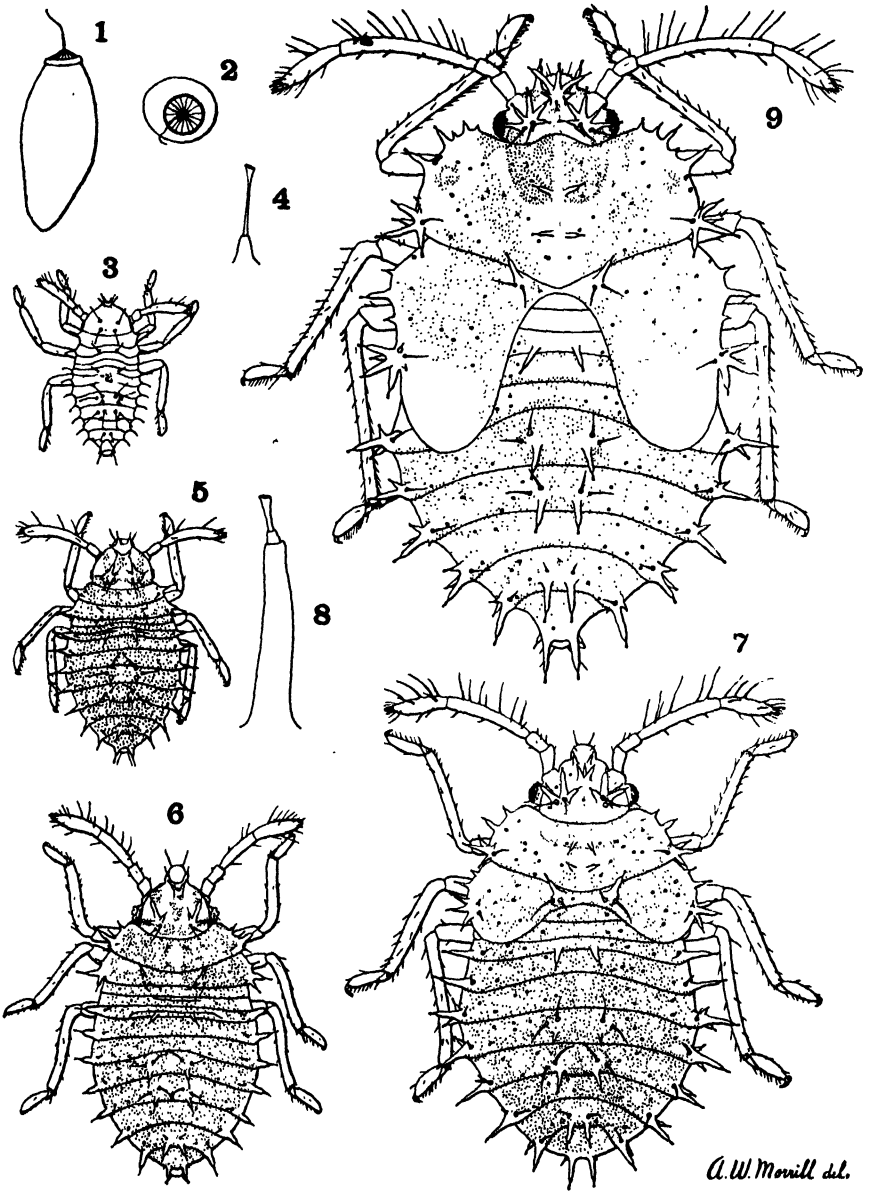
NOTONECTIDAE.

BOTHRONOTUS
biimpressus, 1–231 [China]: Hong Kong.

NOTONECTA
irrorata, 18–443 Mass.: Ipswich, Milton.
shooterii, 44–292 Cal.: San Diego, Los Angeles; L. Cal.: San José del Cabo.

CORISIDAE.

CORISA
acuminata, 48–392 C. Tex.; N. Ill.
decolor, 11–106 Cal.: Clear Lake.
dispersa, 15–841, pl. 42, f. 7 Cal.: Owen's valley; Nev.: near Virginia City; Tex.
harrisii, 18–444 Mass.
inscripta, 44–294 L. Cal.: Cape San Lucas; Cal.; Tex.; Mex.: Orizaba; Ariz.; N. Mex.; S. Cal.
kennicottii, 48–393 Coastal region; [Ill.]: vic. Chicago.
laevigata, 39–384 Ut.: near Salt Lake; Cal.: near San Diego, near San Francisco; Nev.; Wash.; Or.
serrulata, 48–391 Mex.; S. Cal.; Ariz.
substriata, 47–275 Japan.
subtilis, 16–339 Col.
tumida, 17–454 [Col.]: Sloan's Lake, w. of Denver.
vulnerata 3–284 Wash: near Chiloweyuck depot.



MORRILL:—CORYTHUCA.

PSYCHE.

NOTES ON THE IMMATURE STAGES OF SOME TINGITIDS OF THE GENUS CORYTHUCA. PLATE 3.

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The study of these insects by the writer was begun as a consequence of noting the marked difference which was evident between the eggs of the oak-inhabiting TINGIS of this locality and the eggs figured in Comstock's Manual for the Study of Insects as those of *Corythuca arcuata*. Later it was found that the young of the Buttonwood TINGIS (*Corythuca ciliata*) so closely resemble those of the Oak TINGIS as to make their distinction possible only by microscopic examination. Say's description of *Corythuca arcuata* covers several closely allied forms which may be considered species in the process of formation. Others which are recognized as distinct species appear to be very closely allied; at least in their adult condition. The differences, which are noted in this paper, in the immature stages of the Oak, Hawthorn, and Buttonwood tingitids indicate that the relationships of these perplexing forms will be better understood when the egg and nymph stages of each have been studied.

DESCRIPTION OF THE IMMATURE STAGES OF THE OAK TINGIS, *Corythuca arcuata* Say.

Egg (Plate 3, figs. 1 and 2): subelliptical in outline, basal end rather pointed, apical end capped with a narrow cylindrical collar or band surmounted by a low pyramid with from fifteen to twenty ridges extending from the base to the apex. From the apex of this pyramid there usually arises a slender filament which is variable in length but as a rule about one fifth as long as the egg. Below the collar the egg is evenly covered with a thin layer of wax, jet black in color, and rough, resembling sand paper under low power objectives. This outer wax covering may be easily rubbed off, disclosing the smooth shiny black egg chorion. The pyramidal portion of the apical cap may be either whitish or black. The length of the egg, not including the apical filament, is about .56 mm., its greatest width about .24 mm.

For the purpose of simplifying the following description of the nymphs I will designate the three principal types of spines found in the nymph stages as follows:

trumpet-shaped spines which arise from conical, sub-conical, or elongated thick protuberances as *type no. 1;* trumpet-shaped spines which arise directly from the surface of the body or its appendages as *type no. 2;* and long simple spines which arise directly from the surface of the body or its appendages as *type no. 3.*

First instar (Pl. 3, figs. 3 and 4): — Length about .53 mm., greatest width about .24 mm. The general form is an elongated ellipse, the head end being a little more broadly rounded than the anal end. When first hatched the body is pale in color but gradually turns to dark brown and in a few hours acquires a greenish tint. The rostrum, — except the tip which is brown, — antennae, and legs are pale yellowish but soon become greenish. This greenish color of the body and appendages is apparently internal, perhaps due to the blood. The part of the head which projects in front of the prothorax when viewed from above is almost semicircular in outline. The hinder fifth of the head is rounded and covered by the pronotum. The compound eyes consisting of five reddish facets each, are situated on the extreme sides of the head just in front of the pronotum. Anterior to and a little below the eyes arise the three segmented antenna, the first two segments of which are short and stout, subequal in size, the second one bearing a very few slender spines. The terminal segment is about as long as the first two together, clavate, broadest at about three fourths of the distance toward the apex, from which point it tapers gradually toward the base and rapidly toward the tip. It is slightly curved posteriorly and is provided with long spines some of which are of type no. 3 and others of type no. 2, also with many small simple spurs and blunt sense cones near the tip. The entire length of the antenna is about two fifths the length of the body. The rostrum is four segmented and about three fifths as long as the entire body, reaching when bent backwards, to the middle of the fifth abdominal segment. The rostral setae are comparatively stout. The labrum is hyaline and about two thirds as long as the basal segment of the rostrum. Beginning at the upper side of each eye there is a light streak in the integument above, which curves forward and then backward to a point about opposite its origin in the middle line of the head where it meets its fellow and a median longitudinal streak which extends back to the base of the abdomen. It is along these streaks that the integument splits when the insect moults. On each of the two obtuse angles formed by the union of the transverse streaks on the head and the median longitudinal streak are situated two stout spines, one being directly in front of the other, — the posterior spines of type no. 2 being directed posteriorly, the anterior spines of type no. 1 being directed anteriorly. Two very minute spines of type no. 2 arise on each side of the median streak between the bases of the two posterior spines. Near the anterior end of the head there are two more pairs of spines of type no. 1, situated one spine of each pair on each side of the middle line. The subconical protuberances from which the posterior pair of these spines arise, unite at their base.

The thorax from above is about as long as the head from front to rear and is slightly wider than the head at its widest part. The prothorax is a little larger than the mesothorax and the mesothorax is a little larger than the metathorax. The pro- and mesothorax bear on each lateral margin a spine of type no. 1, which with its base is about one sixth the width of the thorax. On each side of the median streak of the prothorax there are two minute circular openings appearing as minute light spots. On each side of the median streak of the mesothorax arises a spine of type no. 1. The legs are quite stout and when straightened are nearly as long as the body. The coxae are stout, nearly as long as broad. The

trochanters appear to be present though difficult to distinguish. The tibiae are a little longer than the femora and more slender, at the tip bearing several short stout spines. The tarsus consist of two segments, the basal segment being small, not very distinct, and triangular in outline viewed from the side; while the last tarsal segment is rounded above, flat below and bears two stout claws at its tip. The two tarsal segments of each leg together are a little more than one half as long as the tibia. A few slender spines occur on the various segments of the legs.

The abdomen consists of ten segments, only nine of which are ordinarily visible from above. The ninth is quite long and bends downward so that the short anal segment is nearly perpendicular to the surface upon which the insect rests. This segment — the tenth — appears kidney shaped when viewed from the side, with the concave surface where the anal opening is situated directed downward. The second to the ninth segments inclusive, bear on their lateral margins, spines of type no. 1 which correspond to those described on the sides of the pro- and mesothorax. The dorsum of the second abdominal segment bears two spines which correspond to those on the dorsum of the mesothorax. The fifth and sixth segments are much swollen in the middle of the dorsum and each of them bears three spines on each side, the posterior one being of type no. 1 and smaller than the other two which are of type no. 2. On each side of the mid-dorsal line of the eighth segment there arises a spine of type no. 2. Directly behind each of these near the posterior margin of the eighth segment arises a spine of type no. 1. Minute pores and spines also occur on the dorsum, the latter being confined mostly to the middle of the sixth segment. A little mesad from each lateral margin, on the ventral surface of the second to eighth segments inclusive, are projections not unlike truncated cones, at the outer, smaller end of which are the tracheal openings. A little mesad to the openings on each side of the body on the venter of each of the fifth, sixth, and seventh segments is a slender spine of type no. 3. On each side of the second to eighth segments about opposite the spiracles viewed from above are small areas bounded by chitinous rings. These structures disappear at the first moult and their significance is not known. They appear to be located just below the surface of the body, hence are not represented in the figure.

Second instar (Pl. 3, fig. 5): Length varying from 1.2 to 1.32 mm.; the greatest width from .68 mm. to .72 mm. The change which occurs at the first moult is not great. The body becomes somewhat broader in proportion to its length. The rostrum reaches to about the caudal margin of the second abdominal segment. The legs are shorter in proportion to the length of the body than before, being a little less than two thirds as long as it. The entire dorsum of the body except for certain definite areas is covered with minute dark colored spines. On the venter these spines occur only near the lateral margin. The dorsal spines of the first instar have been changed in two ways: first, new ones have been added, and secondly, spines of type no. 1 which in the first instar arose from small protuberances (Pl. 3, fig. 4) now arise from protuberances which average about the same length as the spines themselves, which are in most cases actually shorter than before. The principal additions of spines in the head region are: a minute one of type no. 1 added to the pair of the same type which occur just behind the most anterior pair; two small spines of type no. 1 and one small spine of type no. 2 added to each of the next two groups which occur one on each side of the middle line between the eyes. Elsewhere on the dorsum are the following additions: four minute spines of type no. 1 now occur on the prothoracic segment, two on each side of the middle line, one being near the anterior margin and the other near the posterior margin of the segment; on the mesothorax two spines of type no. 2 have been

added on each side of the middle just caudad to the spines of type no. 1 which were present in the first instar; just mesad from the base of each protuberance which gives rise to the marginal spines of type no. 1 on the pro- and mesothorax and on the second to ninth abdominal segments arises a spine which may be either of type no. 2 or of type no. 3; and minute side protuberances giving rise to spines of type no. 1 begin to appear as buds from the protuberances on the margin of the pro- and mesothorax. Here and there among the minute dark spines on the surface of the body are minute circular openings from which, when viewed obliquely, little sac-like bodies are seen to protrude.

Third instar (Pl. 3, fig. 6): Length varying from 1 mm. to 1.06 mm., the greatest width from .52 to .56 mm. This instar does not differ greatly in structure from the previous one. The portion of the antenna which represents the apical segment of the previous instar is now indistinctly divided into two segments, the outer one being slightly shorter than the inner one. The rostrum reaches to about the posterior margin of the first abdominal segment. The pro- and mesothorax are proportionally broader than before and the former is proportionally longer from front to rear. The protuberances which give rise to spines of type no. 1 are now, as a rule, about twice as long as the spines. Nearly all of the spines of type no. 2 of the previous instar are now present in the form of type no. 3. A few spines of type no. 2 appear for the first time on the outer sides of the tibiae. The number of facets of the eyes has increased to eleven or twelve. A few small spines of type no. 1 appear for the first time on the lateral margins of the pro- and mesothorax anterior to those present in the previous instar, and also one or two similar ones arise from the sides of the protuberances which give rise to the spines on each lateral margin of the pro- and mesothorax and of the fourth to seventh or eighth abdominal segments. As a rule there is one which arises from the under side of each of these protuberances. Between the facets on the posterior side of each eye arises a spine of type no. 3.

Fourth instar (Pl. 3, figs. 7 and 8): Length varying from 1.3 mm. to 1.44 mm., greatest width from .74 mm. to .86 mm. The most noticeable change which takes place at the third moult is the first appearance of the wing pads, which arise as curved, backward growths of the sides of the mesothorax, giving this segment of the body a form suggestive of the outline of a dumbbell. The wing pads extend back on each side to a little beyond the anterior margin of the first abdominal segment. The prothorax is proportionally longer than before, and the facets of the eyes are more than twice as numerous as before. The terminal segment of the antenna has not increased in length in proportion to the other segments and is now about two thirds as long as the third or preceding segment. The constriction between the two terminal segments is more marked than before. The rostrum reaches to about the base of the abdomen. Spines of type no. 1 now arise from bases which average about four times as long as the spines. A few more spines of this type have made their appearance arising from the bases of those previously present on the lateral margins of the pro- and mesothorax and of the fourth to seventh segments of the abdomen, and a single one of the same type has arisen independently on the lateral margins of the pro- and mesothorax in front of those which appeared independently in previous instars.

Fifth instar (Pl. 3, fig. 9): Length varying from 1.86 mm. to 2 mm., greatest width from 1.1 mm. to 1.36 mm. Quite a marked change in form occurs at the fourth moult, the most noticeable of which is the increased length of the prothorax in proportion to the length of the body and the increase in length of the wing pads. The prothorax now occupies a little more than one fourth the entire length of the body. The wing pads now extend back on each side a little beyond the posterior margin of the fourth abdominal segment. On the outer

side of each wing pad about four fifths of the distance from the tip to the base is a prominent shoulder. The rostrum reaches to about the middle of the mesothorax. The fourth segment of the antenna is now about one half as long as the third. Spines of types nos. 2 and 3 are more numerous than before on the antennae and legs. On the head four more spines of type no. 1 appear in connection with the group present in the previous instar:—one on each side of the second (next to the anterior) group, and one on each of the two posterior groups. A few small spines of type no. 1 appear for the first time on the sides of the pro- and mesothorax and of the fourth to ninth abdominal segments. The second and third abdominal segments have lost the spines of type no. 1 which in previous instars were present on their lateral margins. The area covered by the minute dark spines is much more limited than before. The integument is shaded with brown as before except where there are large spaces devoid of these small spines; the color here is dull yellow, thus giving a somewhat broken light band across the body in the region of the tips of the wing pads. The facets of the eyes are much more numerous than in the previous instar.

The eggs of the OAK TINGIS are found on the under surfaces of the leaves, usually near the larger ribs and in groups ranging from two or three to more than one hundred in numbers. Single isolated eggs are occasionally found. Judging from the number of eggs as compared with the number of adults early in the summer, many eggs must be laid by each female. During the last few days in May of the present year (1903) it was observed that, on those oak leaves where any of the insects occurred, a male and a female were usually found together; rarely one and still more rarely three and four individuals, were found on a single leaf. On many of the leaves where there was but one pair of the insects the numbers of eggs ranged from twenty-five to fifty.

The nymphs remain together in clusters. Their wanderings on the under surface of a leaf are marked by their shiny, black, rounded excrements which are apparently deposited on the leaf by means of the peculiar tenth abdominal segment already described. The moulted skins of the nymphs remain attached to the leaf by their tarsal claws as already observed by Comstock in the Hawthorn TINGIS.

The upper surfaces, particularly along the sides of the mid ribs, of leaves of badly infested trees, turn dirty pale green, sometimes mottled with reddish, and the ornamental effect of whole trees may be greatly impaired by midsummer unless spraying is resorted to.

From two to three days intervene between each succeeding moult up to the fourth, and from six to seven days between the fourth and fifth moults. The duration of the egg stage is unknown to the writer, but eggs laid on the leaves of certain oaks on the college grounds about the middle of May were unhatched on June first, the time of the present writing.

The adults hibernate beneath the bark, under leaves, and among rubbish.

The writer has found adults of *C. ciliata* hibernating in large numbers in crevices in an old wooden fence which ran below the branches of a buttonwood tree.

A few very small pinkish immature heteropterous insects were once found to be very active in destroying the young nymphs of the Oak TINGIS but none were bred to maturity. The adult form of a well-known predaceous heteropteron — *Triphleps insidiosus* Say — has been found feeding on the young of *C. ciliata* and from the similarity in the general appearance and habits of this adult and the immature forms just mentioned it seems probable that they were of the same species.

A group of oaks on the college grounds gave an excellent opportunity for observations on the food plants of the Oak TINGIS. The following oaks were found to be badly infested: white oak (*Quercus alba*), chestnut oak (*Q. prinus*), English oak (*Q. rubra*), and dwarf chestnut oak (*Q. acuminata*). The following were apparently entirely immune to the attack of the insect although they stood so near to badly infested trees that their branches touched in some cases: scarlet oak (*Q. coccinea*), scrub oak (*Q. illicifolia*), and laurel oak (*Q. laurifolia*). A specimen of mossy cup oak (*Q. macrocarpa*) growing a few hundred yards away was slightly infested.

THE HAWTHORN TINGIS, *Corythuca arcuata crataegi, subsp. nov.*

During the summer of 1902 there was received at the Hatch Experiment Station of the college a branch of hawthorn from Concord, Mass., which was submitted to the writer for examination. The leaves were discolored and practically dead, which condition appeared to be due to a combination of both insect and fungus pests. Among the remains of various insects, a few moulted skins of tingitids were found which corresponded very well with the respective instances of the Oak TINGIS. A few eggs were also found upon the hawthorn leaves which agreed with the figure and description given by Comstock in his report for 1879 (Rept. Comm. Agric., 1879, 1880, p. 221). The eggs are there described as follows: "The eggs of these insects .... are smooth, whitish, glistening, semi-transparent, and ovoid in shape. Their average length is .3 mm. (.01 inch). They are deposited on their broad end, and seem to be somewhat inserted into the substance of the leaf; they are covered completely by a brown, sticky substance which hardens soon after oviposition. It adheres so firmly to the egg, especially to the upper portion, that it is impossible to remove it without crushing the egg. At its upper end this covering of the egg is squarely truncate, giving the whole mass the appearance of the frustum of a cone with a porous lid. .... They

bear a much greater resemblance to certain forms of fungi, notably the genus *Phoma*, and to certain homopterous galls than they do to eggs of any sort." Uhler, to whom were referred the specimens of the Hawthorn TINGIS in his note determining the species said: "Your specimens of TINGIS belong to the genus *Corythuca*, and seem to be a new phytophagic form of *Corythuca arcuata* Say. It will hardly do to make a new species out of this insect, as it is one of the several forms which fit into Say's species. It comes near to the race belonging to the *Juglans nigra*."

Better material than that which I have thus far examined would probably show some differences in the nymphs of the oak- and hawthorn-inhabiting TINGIS but from a comparison of the eggs alone it is evident that the two forms should not be considered identical or even local varieties. I suggest therefore that the subspecific name *Corythuca arcuata crataegi* be used in association with the common name Hawthorn TINGIS, while Oak TINGIS be exclusively used for the common name of *Corythuca arcuata*. Say in his description not having mentioned the food plant, it will be necessary thus to designate a variety as the type of the species, and the oak infesting variety seems to be the most commonly accepted type.

THE BUTTONWOOD TINGIS, *Corythuca ciliata* Say.

While to the naked eye or with a hand lens the young stages of *C. arcuata* and *C. ciliata* are almost inseparable, with a compound microscope, using an objective not lower than one half inch, the two species can be readily distinguished. The most striking characters of each instar of *C. ciliata* by which it can be distinguished from *C. arcuata* are here given: —

First instar: The spines corresponding to types no. 1 and no. 2 are not trumpet shaped but are rounded and much larger at the tip than in *C. arcuata*. Spines corresponding to type no. 2 are especially prominent on the antennae.

Second instar: Most of the spines which correspond in position to type no. 1 in *C. arcuata* are now pointed at the tips; a few have not completely changed from their form in the first instar. The antennae bear prominent spines as before.

Third, fourth, and fifth instars: These stages are best distinguished from the corresponding stages of *C. arcuata* by the presence of spines corresponding to type no. 1 but with the form described in the first instar. The spines on the antennae are less prominent than in the first two instars.

This species was found to be extremely abundant at Amherst, Mass., in September, 1902, on the leaves of a buttonwood or sycamore tree (*Platanus occidentalis*) growing near the college grounds. Many adults were found under the bark as late as the first of June, 1903, but none were found on the leaves. Unfortunately no eggs were collected in the autumn with the other stages, and in the spring none were found in time to allow notes to be made on them for this paper.

EXPLANATION OF PLATE 3.

The Oak TINGIS, *Corythuca arcuata* Say.

Fig. 1. Side view of egg.
Fig. 2. Top view of egg.
Fig. 3. Dorsum of first instar.
Fig. 4. Spine from lateral margin of first instar.
Fig. 5. Dorsum of second instar.
Fig. 6. Dorsum of third instar.
Fig. 7. Dorsum of fourth instar.
Fig. 8. Spine from lateral margin of fourth instar.
Fig. 9. Dorsum of fifth instar.

SOME HITHERTO UNKNOWN NYMPHS OF ODONATA FROM NEW MEXICO.

BY JAMES G. NEEDHAM, LAKE FOREST, ILL., AND T. D. A. COCKERELL, PECOS, N. MEX.[1]

During the year 1902, dragon-fly nymphs were collected in three New Mexico localities, each of which yielded material of interest.

(A.) *Las Vegas Hot Springs*, 6709 ft. alt.

A few years ago some specimens of *Hyponeura lugens* were collected at Las Vegas Hot Springs, and upon investigation it appeared that the species occurred there as a permanently established and tolerably numerous colony. This excited some surprise, as the place is hundreds of miles from the nearest previously-known locality for *Hyponeura*, and is in the Transition zone, where the insect was hardly expected to occur. That the colony was really an isolated one appeared probable not merely from the absence of other New Mexico records, but from the fact that we could not find the species in other localities, such as the Arroyo Pecos, which were very prolific in agrionines. The search for nymphs of *Hyponeura* was at first

[1] The descriptions of the nymphs are by Dr. Needham. The material was collected by Mr. and Mrs. Cockerell, and Mr. Cockerell is responsible for the matter relating to localities, etc.

unsuccessful. The hot springs themselves are apparently too hot for insect life though they contain a variety of algae[1] (*Zygnema cruciatum*, *Oscillaria froelichii viridis*, *O. splendida*, *Stigeoclonium tenue*, *Ulothrix speciosa*, *Zygogonium parvulum*, *Beggiatoa alba marina*, *Oedogonium* sp., *Spirogyra* sp., *Tetraspora* sp., and *Nostec* sp.). The temperature of the water was found to be 121° Fahr. Search was next made in the little streams running from the hot springs, and here nymphs were found, but they proved to be referable to some unknown species of *Argia*. No further investigations were made for several months, but in September *Hyponeura* nymphs were at last found in abundance, clinging to stones in the Gallinas River at Las Vegas Hot Springs. The place where they occurred is just where the hot water runs into the river, and the river is perceptibly warmed in consequence. It does not seem impossible that this condition has permitted the existence of the *Hyponeura* colony (derived in the first instance perhaps from the eggs of some wandering individual), the normal waters of the surrounding region being too cold for the species. At the same place were found larvae of *Anopheles pseudopunctipennis* Theobald, determined by Dr. L. O. Howard who informs us that the species was lately described from Grenada, and is new to the United States, but adds that there is a single specimen in the U. S. Nat. Mus., collected by Belfrage in Texas and hitherto overlooked. Larvae have been sent to Dr. H. G. Dyar, who finds them different from true *A. punctipennis*. There was also collected a leech, *Erpobdella punctata* Leidy (det. J. Percy Moore), apparently new to the fauna of New Mexico. The *Hyponeura* nymphs were not bred to the adult stage, but as the generic characters can be seen in the nymphs, it is safe to assume that the species is the same as that caught flying in the same immediate locality. If the above suggestions concerning the origin and character of the HYPONEURA colony are correct, we may look for signs of modification tending towards the establishment of a new race or species. At present it is not possible to compare sufficient numbers of specimens from different localities to determine whether such modification exists, either in average or absolute characters.

HYPONEURA LUGENS Selys.

A number of nymphs in alcohol, obtained from the Gallinas River, Las Vegas Hot Springs, September, 1902. Apparently none of the specimens are fully grown, but they are large enough to show the main features of the venation of the adult in their developing wings, and thus to render certain their generic determination.

Length 14 mm., gills 5 mm. additional; abdomen 7.5 mm., hind femur 3.5 mm., width of head 3.5 mm., of abdomen 2.5 mm.

Body short, stout, smooth. Head depressed, widest across the rear of the large laterally well-rounded and prominent eyes. Antennae 7-jointed, with the suture between the last two

[1] Collected by Mrs. Cockerell; determined by Miss Smith of the University of Nebraska.

segments feebly developed in the younger specimens, the ratio of length of segments from the base outward being 1 : 1.3 : 2 : 1.5 : 1 : .8 : .5. Hind angles of the head prominent, obtusely rounded, scurfy pubescent, with a wide but shallow notch on the hind margin between them. Labium short, the hinge reaching posteriorly only so far as the middle of the prothorax. Mentum with a very prominent, entire median lobe, and with no mental setae. Lateral lobes short and stout, each with a strong arcuate movable hook and a single weak raptorial seta just before base of hook. The end hook is cut off from the inner margin by a feebly developed notch and above it on the end of the lateral lobe is a second similar but somewhat smaller hook, that is denticulate on its external margin.

Prothorax short, widened and thickened toward its rear margin. Legs short, stout, thinly fringed with hairs. Wing cases (in the oldest of these immature specimens) reaching only the middle of the 2d abdominal segment.

Abdomen cylindric, the segments of nearly equal length, except at ends where somewhat shorter, the 10th segment excised on mid-dorsal margin. Gills oblong, widest just beyond the middle, suddenly contracted to both ends, the superior a little shorter than the laterals, all subinflated in the basal half, and with very prominent lateral carinae along the axis.

Color pattern unusually well developed. General color greenish brown, paler below and on sutures: a mid-dorsal row of pale triangles on the abdominal segments, one on each segment, and a pale line each side, and a row of oblique pale streaks in the darker color of the side margin. There is a blackish lateral band extending from the rear of the eyes along the sides of the head and prothorax. All the femora bear two distinct broad rings of blackish brown, the distal one being the more prominent, the gills are blackish, white tipped, and each shows an imperfect pale subapical transverse band starting inward from the opposite margins and of different extent in different specimens. The depth of color varies greatly with remoteness from time of moulting, but the general pattern is quite apparent in all but the most recently moulted.

Material more recently collected from the same place on March 21st, 1903, includes some larger specimens measuring in length of body 16 mm., having wing cases reaching the middle of the 3d abdominal segment.

This nymph is at once distinguished from our other known agrionine nymphs by a very primitive character: the possession of triquetral gills, having swollen base and thick lateral carinae. Of all the nymphs of Odonata hitherto made known they are most like the fossil nymphs of the genus SAMARURA described by Brauer, Redtenbacher, and Ganglbauer in the Memoirs of the Imperial Academy of St. Petersburgh, vol. 36, 1888, from the Jura formation of East Siberia. The gills are very similar. Nymphs of HYPONEURA agree closely with those of the genus ARGIA, differing chiefly by their much greater size, shorter labium, absence of well developed raptorial setae, and thicker gills. The species of ARGIA from streamlets of warm water above mentioned has triquetral gills, possessing strong lateral carinae, but they are thinner and more pointed than the gills of HYPONEURA nymphs. In *Argia putrida* Hagen, which clings to the rocks in rapid streams or on wave beaten shores, there are feebly developed lateral carinae at the base; but the other species

of ARGIA that live in quiet waters and come into direct competition with nymphs of other genera, have the gills quite thin and flat.

(B.) *The Arroyo Pecos, near Las Vegas.*

The Arroyo Pecos (by no means to be confused with the Pecos River) is a gully to the east of Las Vegas, where a small stream cuts through the fossiliferous Pleistocene beds, and even into the underlying Cretaceous shales. The stream is small and the water is so alkaline that drivers of vehicles crossing it will not usually allow their horses to drink. Here and there are pools and marshy places. On June 7 search was made for Odonata in a marshy place in the arroyo, and along the borders of an artificial pond not far off. Agrionines only were observed breeding, but these were exceedingly numerous. The males were holding the females by the neck with their abdominal appendages, while the latter oviposited in the water. At the same time nymphs were leaving the water, and several placed in paper bags gave forth adult flies. It would seem that either the hatching season is quite prolonged, or else the ovipositing occurs very shortly after emergence. Three species were represented, as set forth below. *Enallagma civile* was very abundant, but *Ischnura perparva* was scarcely less numerous, while *I. damula* occurred in fair numbers around the pond.

ENALLAGMA CIVILE Hagen.

This widely distributed North American ENALLAGMA was bred from nymphs collected at Arroyo Pecos, Las Vegas, N. Mexico on the 7th of June, 1902. The nymphs of this genus are so much alike that it is hardly worth while to repeat the detailed description given in the Bulletin of the New York State Museum. It will be sufficient here to state the more distinctive characters of this species. The immature stages were unknown at the time the above mentioned Bulletin was written.

Length 19–20 mm., gills 6 mm. additional. Form as in others of the genus. Gills without color pattern save for scanty pigmentation along the larger tracheae. Mental setae of the labium four each side, the innermost small, but half as long as the others. Lateral setae 5. End of the lateral labial lobe with end hook as usual, but above it on the margin are three larger followed by three smaller, obsolescent teeth, the latter covering the outer angle.

ISCHNURA PERPARVA Selys.

This little western species was also bred from nymphs collected at Arroyo Pecos, Las Vegas, N. Mexico, on June 7, 1902. Its nymph agrees closely with

that of other members of the genus in general characters as stated in the above cited Bulletin. Its more distinctive characters are the following: —

Length 11 mm., gills 4 mm. additional. Gills plainly colored, a little darker along the axis, but without spots or bands. Mental setae of labium four each side in an equal uniform series; lateral setae 5. On the end of the lateral lobe above the end hook are three distinct teeth, and the obliquely truncated outer angle is obscurely denticulate.

Two pairs of *Ischnura damula* Calvert (recently described in Biol. Centr. Amer., ♂ only) were taken at Arroyo Pecos on June 7 along with the above described forms. Both females are old and pruinose blue. They measure in total length 27 mm., abdomen 20 mm., hind wing 15 mm. There is no ventral spine on the 8th abdominal segment. The stigma is distinctly smaller (smaller by about one third) in the hind wing than in the fore. The hind margin of the prothorax is slightly concave on either side of the dorsum, produced backward in the middle and divided there by a minute median notch. The nasus is metallic green, but the top of the head and thorax, the upper surfaces of the femora, and the whole dorsum of the abdomen (save for invading streaks of yellowish on the sides of the 2d segment) are blackish pruinose.

(C.) *Dimmitt Lake, near Roswell.*

On the east side of the Pecos River, near Roswell, is a line of red bluffs consisting of impure gypsum. At the foot of these bluffs is a series of small lakes, which are so deep as to be popularly reputed "bottomless." These lakes are so strongly impregnated with salts that the water is hardly suitable for drinking purposes. Along their margins dragon-fly nymphs may be found, and dragon-flies (mostly libellulines) were observed to be very numerous.

The identification of the species of *Dythemis* is more or less uncertain. Captain Pope collected on the Pecos River *D. velox* Hag., *D. fugax* Hag., and *D. mendax* Hag. *Dythemis* (now *Brechmorhoga*) *mendax* may be eliminated because its venation does not agree with that of the nymphal wings: as between *D. velox* and *D. fugax*, judging by size alone, the nymphs should belong to the latter, rather larger species, but the former only was collected at the same time and place.

In Proc. Davenport Acad. Sci. vol. 9 (1902), p. 51, it is inferred that Pope collected his material at very different localities above the river, since he obtained both *Melanoplus bivittatus* and *M. differentialis*, which inhabit different life-zones. However, in 1902 it was observed that these two grasshoppers do actually occur together at Roswell. As it is not very likely that their ranges overlap very much,

it thus seems likely that Pope's collections, if all from one place, were from the vicinity of the present town of Roswell, rather than from Lat. 32° (the present boundary between New Mexico and Texas), as Hagen indicates. In all probability, however, the collections were made in several places.

The following species of Odonata were collected at the same place and time as the nymphs described below: *Dythemis velox* Hagen, *Libellula odiosa* Hagen, *Plathemis subornata* Hagen, *Mesothemis collocata* Hagen, *Enallagma civile* Hagen, *E. basidens* Calvert, *Hetaerina americana* Beauv., and a single undeterminable female of a species of ARGIA. Of these, the first five agree perfectly with the descriptions of the types, sent originally by Captain Pope from this same locality.

DYTHEMIS SP.?

Four cast nymphal skins collected at Dimmitt Lake near Roswell, N. Mex., in August, 1902. These constitute a valuable discovery, since no nymphs of this genus or any of its immediate neighbors in the system have been made known hitherto. The generic determination is possible because the venation of the adult is well marked in many important particulars upon the empty wing sheaths.

Length 20 mm., abdomen 12 mm., hind femur 6 mm., width of head 6 mm., of abdomen 7 mm.

Body stout, nearly smooth, depressed. Head widest behind the middle across the rear of the broad eyes, abruptly sloping behind the eyes to the nearly straight, scurfy pubescent hind margin. Antennae slender hardly as long as the head, sparsely hairy toward the tip. Eyes directed antero-laterally. Labium wide, thin; hinge reaching posteriorly as far as the mesothorax. Mentum with a very prominent and broad median lobe whose margin is entire and nearly bare. Mental setae about 12 each side, the outer seven stronger. Lateral lobes broad, lateral setae 10, with a very minute axial seta or spinule at base. Teeth on opposed margins of lateral lobes nearly obsolete, but armed with about four graduated spinules each; at the inner angle are a number of scattered stronger marginal spinules. Movable hook slender and setiform, nearly straight to the incurved tip.

Legs slender, thinly hairy externally. Wing cases reaching posteriorly to the apex of the 6th abdominal segment.

Abdomen triquetral, with sharp lateral margins, the sides nearly parallel except at the ends, abruptly truncated in the rear, hardly narrowed before the 9th segment. Lateral spines on segments 8 and 9, straight and sharp, with finely spinulose external margins, on 8 half as long as the segment, on 9 full as long as the segment. Dorsal hooks on segments 3–9, slender and straight and strongly directed posteriorly, longest on segment 7, where as long as that segment, diminishing in length toward both front and rear: 10th segment short and included in the apex of the 9th. Appendages triquetral, hardly surpassing the level of the tips of the spines of the 9th segment; superior and inferiors equal, the laterals hardly more than half as long.

CLASSIFICATION OF THE GALL-WASPS AND THE PARASITIC CYNIPOIDS, OR THE SUPERFAMILY CYNIPOIDEA. III.

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Subfamily VI.— Xystinae.

1869. Allotrioidae, Familie 3, Förster, Verh. zool.-bot. gesell. Wien, bd. 19, p. 329, 338.
1877. Allotriina, Tribus, Thomson, Opus. ent., fasc. 8, p. 811.
1890. Allotriina, Subfamily, Cameron, Monogr. Brit. Phyt. Hym., vol. 3, p. 157, 232.
1897. Allotriinae, 3e Tribu, Kieffer, Monogr. des cynipides d'Eur., tom., 1, p. 54.
1902. Allotriinae, Subfamille 5, Dalla Torre et Kieffer, Wytsman's Gen. Ins. Fam. Cynipidae, p. 1.
1903. Xystinae, Subfamily VI, Ashmead, Psyche, vol. 10, p. 8.

The species falling in this subfamily are all smooth, highly polished, and are easily recognized by the short, globose, or subglobose, abdomen, the second segment being usually the largest, by the short thorax, the scutellum being convex and smooth, rarely foveated at base, and by the hind tibiae having only *one* apical spur. All the species are genuine parasites and destroy various Aphids (*Aphididae*).

The group seems to form a connecting link between the *Figitidae* and the *Cynipidae*, many of the species closely resembling those in the genera *Ceroptres*, *Neuroterus*, *Dryophanta*, etc.

Two tribes may be distinguished: —

Table of Tribes.

Pronotum laterally and the femora and tibiae toward apex, with broad, foliaceous dilations; claws with a tooth beneath . . . Tribe I. Loboscelidiini
Pronotum and legs normal; claws simple . . . Tribe II. Xystini

Tribe I.— Loboscelidiini.

This tribe is based upon the genus Loboscelidia Westwood, described from Sulu Island, and its position is uncertain. Only a single species is known and that

is a most striking looking wasp on account of the shape of the head and the foliaceous dilations of the thorax and legs. Professor Westwood, uncertain whether it was a cynipid or a proctotrypid, finally placed it doubtfully among the latter in the subfamily *Diapriinae.*

Unfortunately, I have not yet had a specimen for examination, but, judging from Westwood's description and figure, and especially of the venation, I have very little doubt of its being a cynipoid and not a proctotrypoid, so for the present treat it as a tribe in the subfamily *Xystinae.*

Besides the foliaceous dilations on the pronotum, femora and tibiae, it may be recognized by the following characters: —

Wings well developed, with the venation distinct, the marginal cell large, as in *Xystus;* head subglobose, with a short, porrect snout; antennae in ♀ 14-jointed, filiform (♂ unknown) . . . . . Loboscelidia Westwood
(Type L. rufescens Westw.)

Tribe II.— Xystini.

This tribe is distinguished by the head, thorax, and legs being normal, the pronotum and legs always *without* foliaceous dilations. The antennae in the females are 12- or 13-jointed, in the males 13- or 14-jointed.

The species are numerous and attack almost exclusively species belonging to the homopterous family *Aphididae.*

Table of Genera.

Mesonotum entirely *without* parapsidal furrows 1
Mesonotum *with* the parapsidal furrows more or less distinct . . . 7

1. Wings usually fully developed or if abbreviated always *with* a distinctly defined marginal cell 2
2. Wings abbreviated, *without* a marginal cell.
   Antennae in ♀ 13-jointed, in ♂ 14-jointed . Pezophycta Förster
   (Type Xystus brachyptera Hartig.)
3. Marginal cell *open* along the front margin 3
   Marginal cell completely *closed* 5
3. Radius extending to the front margin; antennae in ♀ 13-jointed, in ♂ 14-jointed 4
   Radius *not* extending to the front margin; antennae in ♀ 12-jointed, in ♂ 13-jointed . . . . . Dilyta Förster
   (Type D. subclavata Först.)

4. Scutellum *with* a fovea at base; third abdominal segment longer than the second . . . . . Glyptoxysta Thomson
(Type G. heterocera Thoms.)

Scutellum *without* a fovea at base; third abdominal segment much shorter than the second . . . . . Alloxysta Förster
(Type Xystus macrophadnus Hartig.)

5. Wings abbreviated, not or hardly as long as the abdomen 6

Wings much longer than the abdomen; antennae in ♀ 13-jointed, in ♂ 14-jointed.

Scutellum *with* one or two foveae at base . . Auloxysta Thomson
(Type A. nigripes Thomson)

Scutellum *not* foveate at base . . . . . Xystus Hartig
= Allotria Westwood
(Type A. victrix Westw.)

6. Antennae in ♀ 13-jointed, in ♂ 14-jointed . . . Nephycta Förster
(Type N. discreta Först.)

7. Parapsidal furrows abbreviated; scutellum *without* foveae at base; antennae in ♀ 13-jointed, in ♂ 14-jointed . . . . . Hemicrisis Förster
(Type H. ruficornis Först.)

Parapsidal furrows complete, entire; scutellum *with* one or two foveae at base; antennae in ♀ 13-jointed, in ♂ 14-jointed . . Phaenoglyphis Förster
(Type P. xanthochroa Först.)

Family LIX.— Cynipidae.

1840. Cynipides, Familie (partim), Hartig, Zeitsch. f. ent., bd. 2, p. 187.
1869. Cynipoidae, Familie (partim), Förster, Verh. zool.-bot. gesell. Wien, bd. 19, p. 329.
1877. Cynipina, Sub-familia (partim), Thomson, Opus. ent., fasc. 8, p. 778.
1897. Cynipinae, 2e Tribu (partim), Kieffer, Monogr. des cynipides d' Eur., tom. 1, p. 54.
1902. Cynipidae, Subfamille (partim), Dalla Torre et Kieffer, Wytsman's Gen. Insectorum, p. 42.

To this family, as I have restricted it, belong all the genuine gall-makers, the gall-inhaling species (*Synerginae*), and the *Ibaliinae*, the latter representing a small group of parasites. The gall-makers and gall-inhaling species are very numerous, closely resemble each other, often living side by side together in the same galls, and are separated with difficulty, the experienced eye alone being able to detect the difference. They produce galls or live in galls, on various trees and plants,

the oak, bramble, rose, and various *Compositae* being especially subject to their attacks. From the *Figitidae* they are distinguished principally by abdominal peculiarities, the tergites being shorter and not meeting along the venter, not enclosing or hiding the sternites, as in the former, except in some Anacharines. All, however, have a *habitus* or *tout-ensemble* peculiarly their own, which with practice one soon perceives, and is thus able to recognize the different groups at a glance.

Three subfamilies have been recognized, distinguished by the characters employed in the following table:—

TABLE OF SUBFAMILIES.

Basal joint of hind tarsi usually shorter than joints 2–5 united or never much longer; abdomen not or very little longer than the head and thorax united . 1
Basal joint of hind tarsi at least twice as long as 2–5 united; joints 2–4 scarcely longer than thick, the second with a long spined process outwardly . . 2

1. Second segment in female very large, occupying the whole or nearly the whole surface of abdomen, very rarely showing an indistinct dividing suture; if this suture is distinct or complete it is very oblique and the segment dorsally is fully two thirds the length of the abdomen; males with the second and third segments nearly equal, but here two segments occupy most of the surface of the abdomen; venter more or less covered basally Subfamily I. Synerginae
   Second segment in female much shorter, but the longest segment; the second and third together not occupying two thirds the whole surface or rarely; venter always visible . . . . . Subfamily II. Cynipinae
2. Abdomen very strongly compressed, cultriform, and much longer than the head and thorax united, the four or five basal segments nearly of an equal length . . . . . Subfamily III. Ibaliinae

Subfamily I. Synerginae.

1896. Synerginae, Subfamily VII, Ashmead, Trans. Amer. ent. soc., vol. 23, p. 186.
1900. Synerginae, Subfamily I, Ashmead, Smith's Ins. New Jersey, p. 548.
1901. Cynipinae, 2e Tribu (partim), Kieffer, Monogr. des cynipides d'Eur. tom. 1, p. 54.
1902. Cynipinae, Subfamille (partim), Dalla Torre et Kieffer, Wytsman's Gen. Ins. p. 2.

This group is classified by Dalla Torre and Kieffer among the *Cynipinae;* it is evidently an offshoot of the genuine gall-makers but now sufficiently differentiated in structural characters and in habits to be kept apart. The *Synerginae* may

be popularly known as "the false gall-makers" or Inquilines, since most of them, if not all of them, are not genuine gall-makers, although often mistaken for them; nor are they genuine parasites, *i. e.* they do not destroy the genuine gall-makers; on the contrary all, with possibly two or three exceptions, are inquilines or commensals and merely dwell, often side by side, in the galls made by other insects. Most of them are bred from cynipidous galls, found on oak trees, but some are also bred from galls made by other insects, Diptera, etc., occurring on the oak, willow, etc.

The genus *Synophrus* is said to be a genuine gall-maker as well as the genus *Rhoophilus*, described from Africa and bred from a gall on *Rhus;* but, judging from the structural characters of these wasps I suspect both are really commensals in cynipidous and cecidomyidous galls.

Table of Genera.

Marginal cell completely closed 1

Marginal cell *open* along the front margin 6

1. Face, or at least the cheeks, striated, the striae usually converging towards the mouth; mesopleura longitudinally striated aciculated, rarely smooth . 3

   Face *not* striated, smooth, coriaceous, or punctate; mesopleura smooth, highly polished, or at least not striated.

   Second abdominal segment occupying nearly the whole surface, *without* a trace of a dividing suture; sheaths of ovipositor projecting . . 3

   Second abdominal segment divided into two by a delicate, or a distinct, suture, which is either vertical or oblique 2

2. Suture dividing the second segment distinct and very oblique; extending towards the base of the petiole, the first division appearing tongue-shaped, dorsally long, ventrally very short; sheaths of ovipositor not prominent; antennae in ♀ 13-jointed, the third joint longer than the fourth, in ♂ 15-jointed, the third joint longer than the fourth, excised beneath . Euceroptres Ashmead (Type E. primus Ashm.)

   Suture dividing the second segment very delicate, vertical, the first division not longer dorsally than ventrally; sheaths of ovipositor prominent, projecting; antennae in ♀ 12- or 13-jointed, the third joint not or scarcely longer than the fourth; in ♂ 14- or 15-jointed, the third joint not longer than the fourth, not excised beneath . . . . . Ceroptres Hartig (Type C. clavicornis Hartig.)

3. Mesonotum with the parapsidal furrows complete, distinct; face entirely striated, *without* a smooth median elevation; sheaths of ovipositor usually, but not always prominent 5

Mesonotum with the parapsidal furrows incomplete, wanting, or evanescent anteriorly; face *with* a smooth median elevation, the striae confined to the cheeks and on the space next to the eyes; sheaths of ovipositor prominent 4

4. Antennae in ♀ 12-jointed, the third joint not longer than the fourth, in ♂ 15-jointed, the third joint usually strongly excised . . Periclistus Förster
(Type Aulax cananae Hartig.)

5. Claws simple; petiole of abdomen striated; antennae in ♀ 13-, 14-, or 15-jointed, in ♂ 15-jointed, the third joint scarcely longer than the fourth, excised outwardly towards base . . . . . Synergus Hartig
(Type S. nigripes Hartig.)

Claws with a more or less distinct tooth at base beneath; petiole of abdomen not striated; antennae in ♀ 13-jointed, in ♂ 14-jointed, the third joint longer than the fourth . . . . . Rhoophilus Mayr
(Type R. löwii Mayr.)

6. Scutellum normal, distinctly bifoveated at base; mesonotum *with* more or less distinct parapsidal furrows 7

Scutellum broad, not foveated at base; mesonotum *without* parapsidal furrows. Antennae in ♀ 13-jointed, in ♂ 14-jointed, the third joint much longer than the fourth, strongly excised outwardly . . . Sapholytus Förster
(Type Synergus apicalis Hartig.)

7. Areolet in front wings rather large distinct; the two foveae at base of scutellum very large transverse, separated by a carina; mesothorax transversely rugulose; antennae in ♀ 13-jointed, in ♂ 15-jointed, filiform, the third joint hardly as long as the fourth or no longer . . . . . Synophrus Hartig
(Type S. politus Hartig.)

Areolet in front wings incomplete, the outer side alone present; the two foveae at base of scutellum not large oblique; mesothorax coriaceous, not transversely rugulose; antennae in ♀ 13-jointed, in ♂ 15-jointed, filiform, the third joint much longer than the fourth . . . Synophromorpha Ashm., g. nov.
(Type S. salicis Ashm.)

Subfamily II. Cynipinae.

1900. Cynipinae, Subfamily II, Ashmead, Smith's Ins. New Jersey, p. 548.
1901. Cynipinae, 2e Tribu (partim), Kieffer, Monogr. des cynipides d'Europe tom. 1, p. 54.
1902. Cynipinae, Subfamille (partim), Dalla Torre et Kieffer, Wytsman's Gen. Ins. p. 2.

This subfamily, as I have restricted it, comprises only *genuine* gall-makers, or

cynipoids producing galls or deformations on various trees and plants. The genera and species are numerous, much more numerous than most people imagine, and undoubtedly many genera and species yet remain unknown to us. The National collection contains many undescribed species.

The vast majority of the described species belonging to this subfamily produce galls on oak trees, and on the rose and bramble (blackberry and raspberry), but this is due probably to the fact that the galls made on these trees and plants are much more conspicuous, or the trees and plants themselves are more thoroughly studied, than those on other trees and plants, and when the galls on other trees and plants are more extensively collected and studied, we may expect a wonderful increase in our knowledge of the gall-making cynipoids.

The subfamily *Cynipinae* is dividable into five minor groups or tribes, which appear to be *natural*, since the species falling in each tribe confine their attacks to trees and plants of the same order or family, or closely allied orders or families. The species falling in the tribe *Cynipini*, for example, produce galls only on trees of the order CUPULIFERAE, those of the tribe *Rhoditini* attack the ROSACEACEAE, those of the tribe *Aulacini* attack the COMPOSITACEAE, etc.

These tribes may be recognized by the use of the following table: —

TABLE OF TRIBES.

1. Antennae inserted abnormally high up on the face on an imaginary line drawn across from the apex of the eyes; face with two short, distinct antennal furrows 5

   Antennae inserted normally on or near the middle of the face, or far below an imaginary line drawn across from the apex of the eyes; face without distinct antennal furrows 2

2. Winged forms 3

   Wingless or subapterous forms.

   These are all dimorphic or agamous forms, represented only in the female sex; they produced the fully winged sexual form represented by both sexes (♂ ♀) and are easily recognized by the family characteristics, and produce galls on oak trees, or the *Cupuliferae* in late fall and winter. The sexual form appears in early spring and summer . . . . . Tribe I. — Cynipini

3. Cubitus in front wings wanting or if present originating distinctly *below* the middle of the basal nervure; areolet often entirely absent; abdomen variable.

   Cubitus in front wings rarely entirely absent and originating at or near the middle of the basal nervure, never much below the middle; areolet usually present and lying directly beneath the origin of the radius; abdomen in ♀ sub-

compressed, with the second segment always large, occupying usually about two thirds the whole surface of the abdomen, the hypopygium ending in a blunt hairy process of variable length; scape of antennae obconical, about thrice as long as thick at apex, the third joint always distinctly longer than the fourth. (Producing galls on oaks.) . . . . . Tribe I.—Cynipini

3. Abdomen in ♀ not, or only slightly, compressed at apex, the hypopygium neither prominent nor acutely pointed at apex; scape of antennae about thrice as long as thick at apex 4

Abdomen in ♀ much compressed towards apex, the second segment occupying about two thirds the whole surface, the hypopygium prominent, acutely pointed at apex or plow-share shaped; front wings with the areolet distinct, its base directly beneath the origin of the cubitus; scape of antennae subglobose, hardly twice as long as thick. (Producing galls on rose-bushes, etc., *Rosa* and *Rubus*.) Tribe II.—Rhoditini

4. Abdomen with the second segment large, occupying much more than half the whole surface; front wings with the areolet distinct, lying directly beneath the origin of the cubitus; third joint of antennae longer than the fourth. (Producing galls on maple worts, *Sapindaceae*, maple, *Acer*.) Tribe III.—Pediaspidini

Abdomen with the second segment shorter, occupying scarcely half the whole surface; front wings with the areolet often wanting, or if present *not* lying directly beneath the origin of the radius, usually small; third joint of antennae not or rarely longer than the fourth, usually shorter. (Producing galls on ROSACEAE: *Rubus*, *Fragaria*, *Potentilla*; COMPOSITACEAE: *Lygodesmia*, *Hieracium*, *Lactuca*, *Mulgidium*, *Sonchus*, *Nabalus*, *Taraxacum*, etc.; PAPAVERACEAE: *Papaverus*, *Glaucium*, etc.) . . . . . Tribe IV.—Aulacini

5. Front wings *without* an areolet.
(Producing galls on LEGUMINOSAE: *Acacia*.) . . Tribe V.—Eschatocerini

TRIBE I.—CYNIPINI.

This is the largest and most extensive tribe in the subfamily, and contains many genera and species, and all the species, without a single exception, produce galls on the mastworts (CUPULIFERAE), the oaks (QUERCUS) especially being most frequently subject to their attacks; it is extremely rare for them to attack the chestnut (CASTANEA), or the beech (FAGUS), although their galls are sometimes found on these trees, but the wasps producing them are seldom reared, and are still undescribed.

The numerous genera into which these wasps are now divided, may be recognized by the aid of the following table: —

TABLE OF GENERA.

Apterous or subapterous forms 1
Wings fully developed 11

1. Mesonotum *without*, or with indistinct, or incomplete parapsidal furrows, never deep or sharply defined 2
   Mesonotum *with* deep, sharply defined parapsidal furrows . . . 6
2. Mesonotum with traces of furrows, the furrows, however, never complete 3
   Mesonotum smooth, polished, without a trace of the furrows; face smooth, highly polished.
   Antennae 14-jointed, the third joint not quite so long as the two following united, joints 10–13 a little longer than thick; scutellum small, rounded, convex, with a slight transverse grooved line at base; claws of hind tarsi simple; abdomen bare (agamous ♀) . . Xystoteras Ashmead
   (Type X. vollutelae Ashm.)
3. Antennae 14-jointed 4
   Antennae 13-jointed 5
4. Scutellum triangular or conical, as viewed from above, the apex obtuse, or ending in an obtuse thorn, the base not separated from the mesonotum by a grooved line; body very hairy; face shagreened, opaque; antennae very long; the joints cylindrical, 3 to 5, or to 6, very long, the following gradually shortening; claws of hind tarsi with a tooth towards base beneath; sides of abdomen usually densely pubescent (agamous ♀) . . Philonix Fitch
   = Acraspis Mayr
   (Type P. fulvicollis Fitch.)
   Scutellum rounded or semicircular, always rounded off posteriorly, with a slight arcuate furrow or depression at base, the base separated from the mesonotum by a delicate grooved line and carina; face and mesonotum alutaceous or shagreened; antennae long, the third joint as long or nearly as long as joints 4–5 united, joints 6–13 a little more than twice as long as thick; claws of hind tarsi simple, without a tooth beneath (agamous ♀)
   Zopheroteras Ashmead
   (Type Acraspis vaccinii Ashm.)
5. Scutellum rounded, with indications of foveae on either side at base, or at least depressions, the base separated from the mesonotum by a delicate transverse grooved line; face shagreened or coriaceous, the mesonotum subopaque or

alutaceous; antennae rather short, the third joint a little longer than the fourth; joints 9–12 twice as long as thick; claws of hind tarsi with a tooth at base beneath (agamous ♀) . . . . . Phylloteras Ashmead

(Type Biorhiza rubinus Gillette.)

Scutellum semicircular, bounded by a delicate rim posteriorly, without foveae at base; face smooth, shining, or at the most feebly alutaceous, the mesonotum polished, with traces of furrows anteriorly; antennae somewhat short, the third joint nearly twice as long as the fourth, joints 7–12 scarcely longer than thick; claws of hind tarsi simple . . . . . Trigonaspis Hartig

(Type Cynips megapterus Panz.)

6. Front tibiae outwardly at apex normal, never prolonged into a large spined process, at most only slightly dilated 7

Front tibiae outwardly at apex prolonged into a large, spined process . 10

7. Scutellum laterally immarginal, *without* a frenum; face sometimes with a ridge or carina between the antennae 8

Scutellum laterally margined, or *with* a distinct frenum; face *without* a ridge or carina between the antennae.

Antennae 14-jointed, the third joint scarcely longer than the fourth, joints 11–14 hardly longer than wide; head and thorax shining, but the former more or less coriaceous or alutaceous; scutellum without distinct foveae at base, although there is a slight transverse grooved line; tarsi shorter than tibiae; claws with a tooth within (agamous ♀)

Xanthoteras Ashmead

(Type Biorhiza forticornis Walsh.)

8. Face *with* a distinct median ridge or carina between the antennae; scutellum large, lunate, or semicircular; antennae 14-jointed; hind tarsi as long as their tibiae, the claws simple without a tooth at base beneath (agamous ♀)

Biorhiza Westwood

(Type Cynips aptera Linné.)

Face *without* a distinct median ridge or carina between the antennae; scutellum rounded, convex, or a little longer than wide, and separated from the mesonotum by a delicate grooved line

Antennae 12- or 13-jointed 9

Antennae 14-jointed.

Third joint of antennae long but much shorter than 4 and 5 united, joints 11–13 scarcely twice as long as thick, the last joint hardly as long as the two preceding united; head and thorax alutaceous or shagreened, the pleura finely striated; scutellum small, highly convex, with a distinct transverse fovea at base; hind tarsi longer than

their tibiae, the claws with a distinct tooth at base beneath (agamous ♀) . . . . . Parateras Ashmead
(Type P. hubbardi Ashm.)

9. Antennae 13-jointed, the third joint not quite so long as 4–5 united, joints 9–12 scarcely longer than thick, the last joint as long as the two preceding united; body bare or nearly; frons alutaceous; mesonotum smooth, shining; scutellum without a fovea at base; hind tarsi much shorter than their tibiae, the claws with a blunt tooth at base beneath (agamous ♀)
Sphaeroteras Ashmead
(Type Biorhiza mellea Ashm.)

Antennae 12-jointed, the third joint a little shorter and thicker than the fourth, but equal to the fifth, joints 6–8 gradually shortening, joints 9–11 very little longer than thick, the last joint oblong, fully as long as 10 and 11 combined; head and thorax very closely punctate, hairy, the disk of mesopleura alone polished, but densely pubescent below; scutellum cushion-shaped, a little longer than wide, with two distinct, smooth, lunate foveae at base; hind tarsi not longer than their tibiae, the claws with a tooth at base beneath (agamous ♀)
Trichoteras Ashmead
(Type T. coquilletti Ashm.)

10. Antennae 13-jointed, somewhat thickened, the joints after the third short; claws simple (agamous ♀) . . . . . Belonocnema Mayr
(Type B. treatae Mayr.)

11. Front wings with the marginal cell always open along the front margin, the areolet usually distinct, rarely with the first transverse cubitus wanting, and situated distinctly beneath the origin of the radius or on an imaginary line drawn through the extreme base of the marginal or radial cell.
Mesonotum smooth and shining, or at the most alutaceous or very feebly coriaceous 12
Mesonotum never smooth and shining, shagreened, coriaceous, punctate, rugulose, or very coarsely rugose-punctate, with the furrows more or less distinct 26

12. Mesonotum always longer than wide, with the parapsidal furrows more or less distinct, or at least indicated by slight depressed alutaceously sculptured lines
13
Mesonotum not longer than wide, smooth, highly polished, and without traces of the parapsidal furrows, but with an impression at the base of the scapulae that extends from in front of each tegula obliquely towards base of the scutellum; scutellum with a transverse grooved line at base.

Antennae in ♀ 14-jointed, in ♂ 15-jointed, the first joint of the flagellum shorter than the two following united (sexual form)
Neuroterus Hartig = Ameristus Förster
(Type N. politus Hartig.)

Antennae in ♀ 13-jointed, in ♂ 14-jointed, the first joint of the flagellum very long, bent or curved, and as long or longer than the three following joints united (sexual form) . . . Dolichostrophus Ashmead
(Type Cynips majalis Bassett.)

13. Scutellum *without* foveae at base, or with a transverse arcuate furrow at base; if the foveae are more or less distinct they are separate by a very delicate carina and the mesonotum is *not* separated from the scutellum by a delicate carina and grooved line, the base of the mesonotum having a more or less deep median emargination or depression 14
Scutellum *with* two distinct foveae at base.

14. Scutellum laterally immargined 15
Scutellum laterally margined.
Parapsidal furrows deep, distinct; claws of hind tarsi simple; antennae in ♀ 14-jointed, slender, in ♂ 15-jointed (sexual form) Dryocosmus Girard
(Type D. cirrospilus Girard.)

15. Mesonotum not entirely smooth, alutaceous or very finely coriaceous, with the parapsidal furrows indistinct or vaguely defined, never deep or sharply defined; middle area of metathorax with one or two more or less distinct median longitudinal carinae, claws simple 16
Mesonotum smooth, with deep, distinct, sharply defined parapsidal furrows; claws simple or with a tooth beneath towards base 19

16. No delicate transverse grooved line between the mesonotum and the base of the scutellum, the basal margin of the former arcuately emarginate, the furrow continued towards the tegulae 17
A delicate transverse grooved line between the mesonotum and the base of the scutellum, the basal margin of the former straight 18

17. Temples in ♀ somewhat broad, in ♂ flat, the eyes very large, antennae in ♀ 14-jointed, in ♂ 15-jointed, the third joint the longest (sexual form.)
Neuroterus Hartig = Spathegaster Hartig
(Type Spathegaster petioliventus Hartig.)

18. Head not broadened behind the eyes, the cheeks very short, the malar furrow wanting or subobsolete; scutellum with the foveae united at base; metathorax with two median angular divergent ridges; antennae in ♀ 14-jointed, the third and fourth joints equal, in ♂ 15-jointed (sexual form)
Plagiotrochus Mayr
(Type Cynips ilicis Fabr.)

Head distinctly broadened behind the eyes, the cheeks less than half the length of the eye, the malar furrow sharply defined; scutellum with an arcuate transverse furrow at base; metathorax with the carinae nearly straight and parallel; antennae in ♀ 13-jointed, the joints 3–4 nearly equal, joints 5–13 slightly thicker and subequal in lengths, in ♂ 15-jointed (sexual form)

Loxaulus Mayr

(Type L. mammula Mayr.)

19. Claws simple, without a tooth beneath; antennae in ♀ 13-jointed, the first joint of the flagellum not longer than the second 20

Claws with a tooth at base beneath; antennae in ♀ 14-jointed, in ♂ 15-jointed, the third joint longer than the fourth.

Scapulae smooth, without a trace of a grooved or glabrous line posteriorly (sexual form)? genus.

Scapulae always with a more or less distinct grooved or glabrous line posteriorly (sexual form) . . . . . Dryophanta Förster

(Type Cynips folii Linné.)

20. Head dilated behind the eyes, the cheeks shorter than half the length of the eye; scutellum smooth, with a transverse grooved line at base, separated by a median carina; abdomen large, strongly compressed, lenticular

Chilaspis Mayr

(Type Andricus nitidus Giraud.)

21. Antennae in ♀ 14-jointed, in ♂ 15–17-jointed 21

Antennae in ♀ 16-jointed 25

Second joint of hind tarsi fully as long as the last or longer, if shorter the claws with a tooth at base beneath 22

Second joint of hind tarsi shorter than the last, the claws simple; ♀ antennae 14-jointed, ♂ antennae 15-jointed, the third joint strongly emarginate (sexual form) . . . . . Biorhiza Westwood

(Type Cynips aptera Bosc)

22. Metathorax abruptly declivous posteriorly, with two parallel median carinae, the apex of scutellum projecting far over the metanotum; antennae in ♀ 14-jointed, in ♂ 15-jointed, the third joint very long, strongly emarginate, and thickened at apex; claws with a tooth at base (sexual form)

Trigonaspis Hartig

(Type Cynips megaptera Panzer.)

Metathorax not so abruptly declivous, the scutellum normal, rarely conical or pyramidal, most frequently rounded or cushion-shaped, and not projecting over the metanotum 23

23. Middle lobe of mesonotum *with* a more or less distinct median furrow or at least with a trace of it either posteriorly or anteriorly . . . 24

Middle lobe of mesonotum *without* a trace of a median furrow, smooth and shining, the parapsidal furrows distinct. ♀ antennae 14-jointed, ♂ 15-jointed Liodora Förster

(Type L. sulcata Förster.)

24. Antennae in ♀ 14-jointed, the third joint long, one half longer than the fourth, joints 9–13 about three times as long as thick, the last one half longer than the preceding; ♂ antennae 15-jointed, the third joint long, gradually thickening towards apex and the longest joint, joints beyond all long, cylindrical, subequal; metathoracic carinae divergent posteriorly forming a trapezoidal shaped area; hind claws with an acute tooth at base beneath (sexual form) Sphaeroteras Ashmead

Antennae in ♀ 14-jointed, the terminal joint 2½ times as long as the penultimate and sometimes indistinctly divided, joints 5–13 not longer than wide; ♂ antennae 17-jointed, the third joint very long, curved or bent; scutellum with two large foveae at base; abdomen hardly compressed, with a tuft of wool on each side at base (sexual form) . . . Eumayria Ashmead

(Type E. floridana Ashm.)

25. Second abdominal segment only half the length of the abdomen, the five following segments prominent or distinct; ventral spinule short; claws simple Liebelia Kieffer

(Type L. cavarae Kieff.)

26. Abdomen, especially from the third to the last segment, clothed with a dense, silky pubescence, or at least on the lower two thirds, the head, thorax, and legs also hairy or densely pubescent; head much widened behind the eyes; mesothoracic furrows parallel or nearly so, sometimes wanting anteriorly 27

Abdomen bare or nearly bare, without the dense silky pubescence, the head and thorax at the most sparsely pubescent 31

27. Claws of hind tarsi simple, *without* a tooth beneath . . . 28

Claws of hind tarsi *with* a distinct tooth at base beneath . . 29

28. Antennae in ♀ 14-jointed, long and slender, the last joint somewhat stouter than the second; malar furrow absent; parapsidal furrows not impressed anteriorly; scutellum as long as wide, with a transverse furrow at base formed by a delicate carina, open at both ends (agamous ♀) . Aphilonyx Mayr

(Type Cynips cirricola Giraud.)

29. Mesonotum with complete parapsidal furrows 30

Mesonotum with incomplete parapsidal furrows, abbreviated anteriorly.

Antennae 14-jointed, long slender, very slightly thickened towards apex; flagellar joints 1–5 or 6 very long; second abscissa of radius normal; scutellum rounded, convex, without distinct foveae at base (agamous ♀) Holcaspis Mayr (Type Cynips globulus Fitch.)

30. Scutellum rounded, convex, without distinct foveae at base, although there is usually a distinct, arcuate grooved line at base; antennae 14-jointed, of moderate length, the flagellar joints 1–6 elongate, 7–11 short, rarely much longer than thick; second abscissa of radius somewhat stout and more or less dilated or thickened at apex (agamous ♀) . . . . Dryophanta Förster
(Type Cynips folii Linné.)

Scutellum somewhat broader than long, cushion-shaped with transverse furrows or foveae at base, each closed by a carina externally; antennae 13- or 14-jointed, somewhat shortened and thickened, the pedicel as long as or longer than thick; second abscissa of the radius not stout, slender towards apex
Cynips Linné (Hartig)[1]
(Type? unknown: C. argentea Hartig)

31. Thorax neither especially robust nor so highly convex, and never very coarsely rugoso-punctate, more evenly rugulose, coriaceous, or very finely, closely punctate, never wider than the head and often narrower . . 32

Thorax very robust, wider than the head, highly convex and very coarsely rugose or scabrous, the parapsidal furrows rarely distinct or complete, being more or less obliterated by the rugosities or coarse sculpture; scutellum subquadrate or cushion-shaped, a little wider than long, with very large, deep, approximate, transversely wrinkled foveae at base; claws with a tooth at base beneath; antennae in ♀ 13–15-jointed, in ♂ 15–16-jointed; front wings fuliginous or with a macula or cloud at base of the marginal cell, or along the basal nervure, rarely entirely hyaline . . . . . Amphibolips Reinhard
(Type Cynips spongifica O. S.)

32. Thorax more or less distinctly narrower than the head, the cheeks less than half the length of the eyes 35

Thorax at least as wide as the head, the cheeks at least half the length of the eyes or longer.

Claws of hind tarsi simple, *without* a tooth at base beneath . . 33

Claws of hind tarsi *with* a tooth at base beneath.

Head not widened behind the eyes, the malar furrow distinct; face closely punctate or coriaceous . . . Callirhytis Förster
(Type C. hartigii Förster.)

33. Frons normal, *without* a median carina; mesosternum ecarinate . . 34

Frons excavated, with an elongate median carina; mesosternum elongate with

[1] I still retain *Cynips* Linné, as defined by Hartig, Förster, and Mayr, although the type of the genus was probably the wasp now known as *Rhodites rosae* L.

three carinae, the laterals abbreviated; metanotum with a trapezoidal area Fioria Kieffer Type (Callirhytis marianii Kieff.)

34. Mesonotal furrows rarely complete, vaguely defined or abbreviated anteriorly, the middle furrow of the middle mesothoracic lobe sometimes more or less impressed but never completely defined from base to apex, usually distinct only posteriorly, the glabrous or grooved abbreviated lines anteriorly and on the scapulae frequently present; antennae in ♀ 13–14-jointed, in ♂ 14-, 15-, or 16-jointed; wings usually pubescent . . . . Andricus Hartig (Type A. trilineatus Hartig.)

Mesonotal furrows sharply defined, complete, the middle mesothoracic lobe also with a distinct, entire, median grooved line; scapulae with an abbreviated grooved line; head very full behind the eyes; antennae in ♀ 15- or 16-jointed, the seven joints before the last only a little longer than thick; front wings hyaline, bare or nearly; abdomen ovate, the sheaths of the ovipositor not at all exserted . . . . . Trisolenia Ashmead (Type T. saltata Ashm.)

35. Mesonotum not or scarcely longer than wide, with the parapsidal furrows complete 36

Mesonotum very distinctly longer than wide.

Thorax usually finely transversely rugulose or shagreened, the scutellum a little longer than wide, subconvex, not distinctly separated from the mesonotum by a delicate grooved line at base, but with two minute, transverse oblique, nearly obsolete foveae; scapulae with a trace of a glabrous longitudinal line; head distinctly wider than the thorax, dilated behind the eyes, shagreened; antennae in ♀ 13–14-jointed, the third joint nearly as long as 4–5 united, the 8th joint and those beyond distinctly thicker; wings hyaline, the areolet sometimes incompletely closed; abdomen much compressed, as seen from the side, not or scarcely longer than high Bassettia Ashmead (Type B. floridana Ashm.)

36. Mesonotum with the parapsidal furrows complete but delicate and somewhat widely separated, the scapulae with a grooved line, the scutellum cushion-shaped, a little longer than wide, with an arcuate transverse impressed line at base due to the union of the two shallow, scarcely perceptible foveae; head wider than the thorax, dilated and bulging out behind the eyes; antennae in ♀ long, 13- or 14-jointed, with joints 3–5 equal or very nearly; front wings with a macula or cloud at base of the marginal cell and also more or less along the basal nervure; abdomen strongly compressed, lenticular, not longer than high, as seen from the side, with the sheaths of the ovipositor prominent Compsodryoxenus Ashmead (Type C. maculipennis Ashm.)

SYNOPSIS OF THE NORTH AMERICAN SPECIES OF AMMOPHILA.

BY A. L. MELANDER, CHICAGO, ILL.

Recently through the kindness of the authorities of the Academy of natural sciences of Philadelphia I had the opportunity of studying the types of AMMOPHILA contained in their collection. A synopsis of the species was arranged in tabular form with the intention of further work on the group. As this plan cannot now be carried out it seems advisable to publish the notes made while in Philadelphia for the assistance of any who wish to study this interesting genus. In the original table have been interpolated the additional North American species not contained at the Philadelphia academy, their places having been determined from the descriptions alone. Owing to the incomplete diagnoses of some authors a number of these species have been placed out of their natural order, and hence the table is in part more artificial than is to be desired; but in the main a natural relationship is expressed.

It is strange that the study of such large, common, and intelligent insects should have been so long neglected. Possibly this is due to the uncertainty in the determination of the species of the older authors and to the confusion existing between the homonymous but different species of Dahlbom and Lepeletier. But as in the northeastern part of the United States the species are not numerous the student of at least that section should experience but little trouble in naming his captures. For example, some two hundred specimens collected by myself in central and southern Texas, Illinois, and New England yield only three PSAMMOPHILAS, nine AMMOPHILAS and the one COLOPTERA, thirteen species, of which ten are found in the Northeastern States. In order of abundance of individuals these species are: *procera*, *nigricans*, *urnaria*, *violaceipennis*, *extremitata*, *inepta* (Tex.), *abbreviata*, *vulgaris*, *grossa* (Tex.), *luctuosa*, *gracilis*, *wrightii* (Tex.), and an undescribed species from Illinois. It will be noticed that most of these are the species of the older authors. On account of the brevity of their descriptions the determination of these can best be accomplished by eliminating the other species found in the type locality. By this method, and as they seem to be the most abundant forms, the older species can be readily fixed. A careful redescription of them is desired from the next monographer.

A number of changes in nomenclature are instituted, whereby several well-known names are dropped as synonyms. The dubious *violaceipennis* is a common form of the United States, concerning whose identity it is indeed strange that a doubt should ever have existed. The Brazilian *urnaria* of Lepeletier is not the

same as Dahlbom's species; *procera* Lep. is not *procera* Dahlb., but is the other sex of his *intercepta* and both are synonyms of *nigricans* Dahlb.: *gracilis* Cam. is not *gracilis* Lep., while the Canadian form of same name seems to be a third species.

With such well-known and long established names as *cementaria*, *gryphus*, *procera*, *robusta*, *macra*, *anomala*, etc., untenable, the future student will hesitate before describing new species. However the Mexican and Central American species of Peter Cameron seem valid and in little danger of confluence. The stumbling block of the earlier describers has often been the association of the sexes, since a distinct dimorphism often prevails. Generally the males are more slender, more hirsute, and more brilliantly marked than the females, and in those species with the abdomen partially red the males frequently have the black encroaching dorsally as a median line. Their clasping sexual organs and the narrow and straight-sided face are distinctive of this sex.

Of the species of the United States some difficulty might be experienced in differentiating between certain forms. For this reason a few supplementary notes on the common species are added:—

vulgaris is a small species, about three fourths of an inch in length. The mesonotum of the female generally has a deep median furrow. The striae of the metanotum are close together, oblique and well-cut, and are generally connected by a median line.

juncea is founded on a slender male with very fine transverse metanotal striae. The central portion of the disc is sometimes confusedly punctate and slightly hairy. It is a larger form than *vulgaris*.

strenua is about one inch in length and has complete transverse striae on the metanotum not quite so well marked as in *vulgaris* but rougher than in *juncea*. The anterior striae tend to become oblique. The female has a short narrow impressed line on the mesonotum.

urnaria. The obsolete striate arrangement of the punctures near the tegulae is quite characteristic and fairly constant in this species. The rather coarse striae of the metanotum are more or less oblique and frequently become rugulose on the disc as in *juncea*.

abbreviata is quite distinct among the local species by the acuminate clypeus of the male, the short pale golden macule of the mesopleurae, and the black abdomen.

nigricans also has the abdomen mostly black but the pleurae are entirely black and the wings darkened.

extremitata is quite distinct by the yellowish wings. The thorax of the female is matte-black and the abdomen contains a brighter red than in the other common forms.

procera is the only local species with complete and coarse transverse striae on the notum. It is also the largest of our species, some specimens attaining nearly an inch and a half in length.

It is believed that the following table will give a truthful determination of the species of this group as they have been defined, and since the species need no longer be confused it is hoped that an interest in their study may be aroused. Especially to be desired is the observation of the habits of these intelligent wasps, — a pleasant research, — for the ammophiles are intellectually superior to the other fossorial Hymenoptera, as the entertaining records of Fabre, the Peckhams, Williston, and others have shown.

TABLE OF THE NORTH AMERICAN SPECIES.

Front wings with three submarginal cells, submedian cell but little shorter than the median . . . . . 2.
Front wings with but two submarginal cells . . . . . 3.
2. Petiole of abdomen consisting of the first abdominal segment only (PSAMMOPHILA) 4.
Petiole of abdomen consisting of the entire first segment and at least the basal portion of the second . . . . . (AMMOPHILA) 18.
3. Second and third submarginals united. Black species with the base of the abdomen red (anomalous species of *Ammophila*) 74.
Third submarginal cell wanting; submedian cell distinctly shorter than the median (COLOPTERA) 75.
4. Body wholly black, piceous-black, or blue-black . . . . . 5.
Abdomen more or less ferruginous . . . . . 7.
5. Metanotum centrally opaque, closely punctured . . . 10. *piceiventris* Cam.
Metanotum shining, transversely striolate . . . . . 6.
6. Slender; pubescence in part whitish; face silvery; abdomen more or less purplish 2. *luctuosa* Sm. ♂.
Robust; pubescence black; face broad, black pubescent; abdomen black 2. *luctuosa* Sm. ♀.
7. Pubescence of thorax wholly black . . . . . 8.
Pubescence more or less brownish, gray, or white . . . . . 13.
8. Abdomen except the petiole entirely ferruginous . . . . . 9.
Abdomen proper in part black . . . . . 11.
9. Clypeus broadly projecting in the middle, the projection sinuated . 6. *jason* Cam.
The margin of the clypeus pluridentate . . . . . 10.
10. Wings with a yellow tinge; metanotum obliquely rugose . . 3. *valida* Cress.
Wings with a violaceous tinge; metanotum transversely striolated 11. *quadridentata* Cam.
11. Metathorax rugose; wings violaceous . . . . . 8. *sonorensis* Cam.
Metathorax trans-striate; wings violaceous-black to subhyaline . . . . 12.
12. Petiole of abdomen short, not extending beyond the hind trochanters; large species 4. *grossa* Cress. ♀.

Petiole extending beyond the hind trochanters; smaller species variable in pubescence and wing-coloration . . . . . 1. *violaceipennis* Lep.

13. Third submarginal cell small, barrel-shaped; eyes strongly convergent below 12. *pacifica* Mel. and Br.

Third submarginal normal, *i. e*, broader below than above . . . . . 14.

14. Front and middle legs in part red . . . . . 9. *morrisoni* Cam.

Legs entirely black . . . . . 15.

15. Petiole of abdomen short, not extending beyond hind trochanters; stout species 4. *grossa* Cress. ♂.

Petiole much longer; smaller species . . . . . 16.

16. Base of abdomen entirely ferruginous . . . . . 17.

Only the sides of the first and second segments reddish . . . 5. *montana* Cam.

17. Legs densely pruinose . . . . . 7. *alpestris* Cam.

Legs sparsely pruinose . . . . . 1. *violaceipennis* Lep. ♂.

18. Pro- or meso-notum transversely strigose . . . . . 19.

Disc of thorax punctured or smooth, never with complete transverse strigae . 34.

19. Thorax or legs in part red . . . . . 20.

Ground color of thorax and legs entirely black . . . . . 21.

20. Head red; metanotum transversely striate . . . . 28. *ferruginosa* Cress.

Head black; metanotal striae becoming rugose laterally . . . 30. *collaris* Cress.

21. Abdomen wholly black above . . . . . 22.

Abdomen in part red above . . . . . 27.

22. Scutellum with strong longitudinal carinae . . . . . 43. *ceres* Cam.

Scutellum with longitudinal grooves or simply punctate . . . . . 23.

23. Pleurae with golden to silvery spots; abdomen almost wholly black; clypeus of male acuminate . . . . . 24.

Pleurae with elongate silvery markings; third ventral in part red; clypeus of male not produced . . . . . 25.

24. Tip of metapleurae with a marking of silvery pubescence . 13. *abbreviata* Fabr.

Tip of metathorax not marked with glistening pubescence . 42. *aureonotata* Cam.

25. Face with silvery pile and pubescence; metathorax transversely striate 17. *gracilis* Lep.

Face more or less silvery but with black pubescence also; metanotum with oblique striae at least in part . . . . . 26.

26. Prothorax shorter, sculpture of thorax coarser and insect more pubescent 23. *barbata* Sm.

Prothorax longer and comparatively stout; sculpture of thorax less coarse 16. *procera* Dahlb.

27. Black pilose species; upper part of metathorax velvet black, and arcuately strigose; wings fulvous . . . . . 31. *extremitata* Cress. ♂

Not such species; pile in part lighter . . . . . 28.

28. Metapleurae rugosely punctate . . . . . 29.

Metapleurae strigose . . . . . 33.

29. Clypeus coarsely punctured; mesothorax punctured at middle but becoming strigose at the sides; disc of metanotum obliquely striated . . . 27. *conditor* Sm.

Species not conforming with all these characters . . . . . 30.

30. Face with whitish pubescence; abdomen largely red . . . . . 31.

Face with black pubescence . . . . . 32.
31. Legs completely black . . . . . 32. *polita* Cress.
Legs densely pruinose . . . . . 46. *striolata* Cam.
32. Prothorax transversely striate . . . . . 45. *championi* Cam.
Prothorax smooth . . . . . 25. *placida* Sm.
33. Abdomen almost wholly red . . . . . 26. *saeva* Sm.
Petiole and apical part of abdomen black . . . . . 16. *procera* Dahlb.
34. Legs at least in large part red . . . . . 35.
Ground color of legs wholly black or piceous . . . . . 40.
35. Head and clypeus black; metanotum at least centrally with transverse striae . 36.
Metanotum sharply, densely, and obliquely striated; face and clypeus silvery 19. *aberti* Hald.
36. Sides of thorax with markings of silvery pubescence; central part of metanotum pubescent . . . . . 37.
Pleurae and metanotum not pubescent, pleurae with three large silvery pruinose spots 60. *femur-rubrum* Fox
37. First joint of petiole black, *i. e.*, with more black than second joint . . . 38.
First joint of petiole with more red than second joint; species of 16–25 mm. 29. *pruinosa* Cress.
38. Pleurae with dense matted pubescence; species of 35 to 40 mm. 24. *yarrowi* Cress. ♀.
Pleurae with sparser more erect hairs; species under 30 mm. . . . . 39.
39. Base of femora black; thorax not densely pubescent above . . 21. *breviceps* Sm.
Four anterior legs red; thorax densely pubescent above . . . 58. *comanche* Cam.
40. Wings yellowish or fulvous . . . . . 41.
Wings dark-violaceous to subhyaline . . . . . 42.
41. Head and thorax matte-black, sparsely black pilose . . 31. *extremitata* Cress. ♀.
Head and thorax bluish, densely fusco-pilose . . . . 44. *zanthoptera* Cam.
42. Mesopleurae with spots or oblique stripings of silvery golden color . . . 43.
Pleurae uniform in color, not with pubescent markings . . . . . 61.
43. Thoracic notum with appressed sericeous pubescence and erect hairs . . . 44.
Thorax devoid of dense appressed pubescence but often with sparse to dense hairs and sometimes more or less pruinose . . . . . 48.
44. Central space of metathorax closely pubescent . . . . 24. *yarrowi* Cress.
Metathorax not pubescent centrally . . . . . 45.
45. Abdomen largely red, the segments with a black dorsal spot . . 61. *nasalis* Prov.
Abdomen nearly or wholly black . . . . . 46.
46. The dilated part of the second segment except its hind margin red 18. *arvensis* Lep.
Abdomen completely blue-black; third submarginal narrow; the sericeous pubesence confined to the front part of the thorax . . . . . 47.
47. Metapleurae coarsely striated; hind coxae covered with silvery pubescence 37. *miliaris* Cam.
Metapleurae finely rugulose; hind coxae silvery above only . 13. *abbreviata* Fabr.
48. Central part of metathoracic disc rugulose, scutellum with longitudinal striae 20. *fragilis* Sm.
Central part but little roughened, generally more or less striated . . . . 49.
49. Small species clothed with silvery cinereous pubescence; metanotum with well-marked oblique striae generally connected by a median line . . 33. *vulgaris* Cress.

Species of other character, the metanotum only rarely with a median line . . 50.

50. Face covered with golden pubescence; abdomen largely reddish; clypeus not produced . . . . . 51.

Pubescence of face of other color, if golden the abdomen is black and the clypeus of the male is produced . . . . . 52.

51. Punctures of thorax fine and sparse; scutellum strongly furrowed 57. *chiriquensis* Cam.

Punctures of thorax close; scutellum rugose . . . . . 53. *dejecta* Cam.

52. Head and thorax with sparse black but no silvery pubescence . . . . 53.

Pubescence of head (inclusive of face) and thorax in part silvery, gray, or fuscous 55.

53. Mesonotum strigose or very thickly punctate towards the sides. Eastern species. 14. *urnaria* Dahlb.

Mesonotum simply punctate. Mexican species . . . . . 54.

54. Ground color black over all . . . . . 40. *iridipennis* Cam.

Abdomen with the second segment red . . . . . 50. *consors* Cam.

55. Scutellum sparsely punctate . . . . . 56.

Scutellum deeply channeled longitudinally . . . . . 59.

56. Silvery mark of mesopleurae elongate; base of abdomen red . . . . 57.

Pleural spots short; abdomen nearly black; third submarginal cell narrow; clypeus of male produced . . . . . 58.

57. Dorsal furrow of mesonotum deep . . . . . 35. *strenua* Cress.

Dorsal furrow of mesonotum indistinct . . . . . 52. *montezuma* Cam.

58. Metapleurae finely rugulose; third antennal joint nearly twice the length of the second 13. *abbreviata* Fabr.

Metapleurae coarsely striated; third antennal joint one fourth longer than the fourth 37. *miliaris* Cam.

59. Thorax nearly impunctate, but covered with dense silvery pubescence; slender species 36. *juncea* Cress.

Thorax strongly punctured, its pubescence with long darker hairs intermixed. Mexican species . . . . . 60.

60. Third submarginal cell twice as wide at the bottom as at the top 55. *azteca* Cam.

Third submarginal only one fourth longer at the bottom than at the top—*gracilis* Cam.

61. Wings blackish; thorax black-sericeous; pubescence dense ♂, or sparser ♀ 15. *nigricans* Dahlb.

Wings sub- or fusco-hyaline . . . . . 62.

62. Abdomen without red markings . . . . . 63.

Abdomen in part red . . . . . 65.

63 Blue-black species; pleurae more or less shining; face with sparse silvery pubescence 64.

Black species; pleurae opaque . . . . . 41. *centralis* Cam.

64. Pubescence sparse; hind tibiae with fulvous hairs . . . 38. *gaumeri* Cam.

Pubescence dense, fuscous; legs with almost no hairs . . . 39. *micans* Cam.

65. Thorax opaque matte velvet-black on the sides; species of the United States . 66.

Pleurae not matte-black . . . . . 67.

66. A spot of golden pubescence above the base of the middle and hind coxae 31. *extremitata* Cress.

No such spots present . . . . . *extremitata* var. *pictipennis* Walsh.

67. Pro- and meso-thorax silvery pruinose. Cuba. . . . . 62. *guerinii* D. T.

Thorax not pruinose; more or less polished. Mexico . . . . . 68.
68. Metathorax transversely striate . . . . . 71.
Metathorax transversely rugose or punctured . . . . . 69.
69. Antennae reddish; scutellum channelled . . . . . 49. *picipes* Cam.
Antennae black; scutellum rugose . . . . . 70.
70. Face golden-pubescent . . . . . 47. *alticola* Cam.
Face with sparse black hairs only . . . . . 22. *atriceps* Smith.
Face with silvery pubescence and black hairs . . . . . 48. *trichiosoma* Cam.
71. Scutellum rugose or coarsely punctured . . . . . 72.
Scutellum deeply longitudinally channeled . . . . . 73.
Scutellum finely punctured; sides of thorax silvery pubescent 50. *consors* Cam. ♂.
72. Thoracic punctures close; metathorax trans-striate; hairs of face sparse 51. *nigrocaerulea* Cam.
Sculpture of thorax indistinct, the metanotal striae oblique; hairs of face dense and silvery in the male . . . . . 34. *mediata* Cress.
73. Thorax shining, punctured . . . . . 54. *cora* Cam.
Thorax opaque, finely rugose . . . . . 56. *voltanica* Cam.
74. Pubescence of body white . . . . . 59. *nearctica* Kohl.
Pubescence of body black . . . . . 31. *extremitata* Cress. ♂.
75. Small slender reddish species with long petiole and transversely striate thorax 63. *wrightii* Cress.

The following list includes the species of this group which have been described as from North America. The species are given in chronological order and show no phyletic sequence.

PSAMMOPHILA Dahlbom.

1. *violaceipennis* Lep., Hym., vol. 3, p. 370. (1845). Amer. bor.
cementaria Smith, Cat. Hym. Brit. mus., vol. 4, p. 223. (1856).
robusta Cress., Proc. Ent. soc. Phil., vol. 4, p. 461. ♀. (1865).
communis Cress., ibid., p. 462. ♂.
2. *luctuosa* Smith, Cat. Hym. Brit. mus., vol. 4, p. 224. ♀. (1856). Can. U. S., Mex., Cuba.
argentifrons Cress., Proc. Ent. soc. Phil., vol. 4, p. 462. ♂. (1865).
mexicana Sauss., Reise Novara. Hym., p. 25. (1868).
3. *valida* Cress., Proc. Ent. soc. Phil., vol. 4, p. 461. ♀. (1865). Col.
4. *grossa* Cress., Trans. Amer. ent. soc., vol. 4, p. 209. ♀. (1872). Tex.
Melander and Brues, Biol. bull., vol. 2, p. 41. ♂. (1902).
5. *montana* Cameron, Biol. Cent.-Amer. Hym., vol. 2, p. 20. ♂. (1888). Mex.
6. *jason* Cam., ibid., p. 20. ♀. Guatemala.
7. *alpestris* Cam., ibid., p. 21. ♂. Panama.
8. *sonorensis* Cam., ibid., p. 21. ♀. Mex.
9. *morrisoni* Cam., ibid., p. 21. ♂. Mex.
10. *piceiventris* Cam., ibid., p. 22. ♀. Guatemala.
11. *quadridentata* Cam., ibid., p. 23. ♀. Mex.
12. *pacifica* Melander and Brues, Biol. bull., vol. 2, p. 42. ♂. (1902). Cal.

AMMOPHILA Kirby.

13. *abbreviata* Fabr., Syst. Piezatorum, p. 204. ♂ ♀. (1804). U. S., Mex., S. Amer.
14. *urnaria* Klug. Dahlb., Hym. Eur., vol. 1, p. 14, (1843). U. S.
15. *nigricans* Dahlb., ibid., p. 14. ♂. Amer. bor.
    intercepta Lep., Hym., vol. 3, p. 378. (1845).
    procera Lep., ibid., p. 376. ♀. (1845).
    macra Cress., Proc. Ent. soc. Phil., vol. 4, p. 460. ♂. (1865).
16. *procera* Klug. Dahlb., Hym. Eur., vol. 1, p. 15. ♂ ♀. (1843). Amer. bor.
    gryphus Smith, Cat. Hym. Brit. mus., vol. 4, p. 222. (1856).
17. *gracilis* Lep., Hym., vol. 3, p. 381. ♂ ♀. Can. U. S. Mex. (nec *gracilis* of Cameron).
18. *arvensis* Lep., ibid., p. 384. ♂ ♀. Amer. bor.
19. *aberti* Haldeman, Stans. Gt. Salt Lake Exp., 368. (1852). West U. S.
    Patton, Bull. U. S. geol. surv., vol. 5, p. 353. ♀ ♂. (1879).
20. *fragilis* Smith, Cat. Hym. Brit. mus., vol. 4, p. 219. ♂ ♀. (1856). Brazil, Mex., Costa Rica. Tex.
    inepta Cresson, Trans. Amer. ent. soc., vol. 4, p. 209. ♂ ♀. (1872).
21. *breviceps* Smith, Cat. Hym. Brit. mus., vol. 4, p. 221. ♀. (1856). Mex.
    varipes Cress., Proc. Ent. soc. Phil., vol. 4, p. 457. ♂ ♀. (1865). Col. Mex.
22. *atriceps* Smith, Cat. Hym. Brit. mus., vol. 4, p. 221. ♂ ♀. (1856). Mex.
23. *barbata* Smith, Ann. mag. nat. hist., (4), vol. 12, p. 260. ♀. (1873). Mex.
24. *yarrowi* Cress., Rept. Geogr. geol. surv., 100th mer., vol. 5, p. 713. ♂. (1873). Col.
25. *placida* Smith, Cat. Hym. Brit. mus., vol. 4, p. 221. ♂. (1856). Cal.
26. *saeva* Smith, ibid., p. 222. ♀. Cal.
27. *conditor* Smith, ibid., p. 223. Fla.
28. *ferruginosa* Cresson, Proc. Ent. soc. Phil., vol. 4, p. 455. (1865). Col.
29. *pruinosa* Cress., ibid., p. 455. Col.
30. *collaris* Cress., ibid., p. 456. Col.
31. *extremitata* Cress., ibid., p. 457. Col., Tex., Ill., N. Mex.
    pictipennis Walsh, Amer. ent., vol. 1, p. 164. (1869).
    anomala Taschenberg, Zeitschr. ges. naturw., vol. 34, 434. (1869). Ill.
32. *polita* Cress., Proc. Ent. soc. Phil., vol. 4, 458. ♀. (1865). Col.
33. *vulgaris* Cress., ibid., p. 458. ♂ ♀. Col., Tex., N. Mex., Ill.
34. *mediata* Cress., ibid., p. 459. ♂ ♀. Col.
35. *strenua* Cress., ibid., p. 459. ♀. Col., N. Mex.
36. *juncea* Cress., ibid., p. 460. ♂. Col.
37. *miliaris* Cameron, Biol. Centr.-Amer. Hym., vol. 2, p. 3, ♂. (1888). Guatemala, Panama
38. *gaumeri* Cam., ibid., p. 4. ♂. Guat., Mex.
39. *micans* Cam., ibid., p. 5. ♀. Guat.
40. *iridipennis* Cam., ibid., p. 5. ♂ ♀. Guat.
41. *centralis* Cam., ibid., p. 6. ♂. Guat.
42. *aureonotata* Cam., ibid., p. 7. ♂ ♀. Mex.
43. *ceres* Cam., ibid., p. 8. ♂. Guat.
44. *zanthoptera* Cam., ibid., p. 8. ♀. Guat.
45. *championi* Cam., ibid., p. 9. ♀. Guat.

46. *striolata* Cam., ibid., p. 10. ♀. Mex.
47. *alticola* Cam., ibid., p. 10. ♂. Mex.
48. *trichiosoma* Cam., ibid., p. 11. ♂. Guat.
49. *picipes* Cam., ibid., p. 11. ♂. Mex.
50. *consors* Cam., ibid., p. 12. ♂ ♀. Mex.
51. *nigrocaerulea* Cam., ibid., p. 12. ♂. Mex.
52. *montezuma* Cam., ibid., p. 13. ♂. Mex.
53. *dejecta* Cam., ibid., p. 14. Mex.
54. *cora* Cam., ibid., p. 14. ♂. Guat.
55. *azteca* Cam., ibid., p. 17. ♀. Mex.
56. *voltanica* Cam., ibid., p. 17. ♀. Panama.
57. *chiriquensis* Cam., ibid., p. 18. ♀ Panama.
58. *comanche* Cam., ibid., p. 19. Mex.
59. *nearctica* Kohl, Verh. zool.-bot. ges. Wien, vol. 34, p. 18. ♂. 1889. Wash.
60. *femur-rubrum* Fox, Proc. Cal. acad. sci., (2), vol. 4, p. 102. ♀. (1894). L. Cal.
61. *nasalis* Provancher, Nat. can. vol. 20, p. 111. ♂. (1895). Cal.
62. *guerinii* Dalla Torre, Cat. Hym., vol. 8, p. 400. (1897). Cuba.
apicalis Guérin, Icon. reg. anim., vol. 7, p. 435. (1845).

COLOPTERA Fabr.

63. *wrightii* Cresson, Trans. Amer. ent. soc., vol. 4, p. 378. ♀. (1872), Tex., N. Mex.

HULL ZOOLOGICAL LABORATORY
The University of Chicago,
May 25, 1903.

THE NORTH AMERICAN ANTS OF THE GENUS STENAMMA SENSU STRICTO.[1]

BY WILLIAM MORTON WHEELER, AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, N. Y.

There is a good deal of confusion in regard to the two described North American species of STENAMMA *sensu stricto*, owing to imperfect knowledge of the sexual forms of one of the species. *Stenamma nearcticum* was described by Mayr from two male and two female specimens taken towards the end of October in California. To the same species he referred two workers, one from New Hamp-

[1] Contributions from the Zoological Laboratory of the University of Texas. No. 51.

shire and one from Virginia. Later he withdrew the description of the workers and left the species to rest on the descriptions of the winged forms alone. The other species (*S. brevicorne* Mayr) was described at length from worker and female specimens taken in Virginia.

In his revision of the North American STENAMMA, Emery regarded *nearcticum* as a subspecies of the European *S. westwoodi*, and referred to this same form his own subspecies *diecki* with its variety *impressum*.

More recently Forel has again revised the species, prefacing his conclusions with the following remarks: "This subgenus (STENAMMA *sens. str.*) presents an almost inextricable tangle of allied forms. The sculpture of the American species is denser than that of *S. westwoodi* of Europe. I believe that they should be separated specifically, if only for the sake of unravelling the tangle. On the other hand, I doubt whether *S. diecki* Emery really belongs to *nearcticum* and believe that it belongs rather to *brevicorne*. Emery gives the differential characters between the American workers and the typical *Westwoodi* but not between the workers of *nearcticum* and *brevicorne*. Now the fundamental difference between these two species lies in the wings, and none of the specimens described by Emery as *nearcticum*, *diecki*, etc., seem to have possessed these appendages, as the author makes no mention of them. It seems to me more prudent, therefore, since the winged sexes are so little known, to retain the name *nearcticum* only for the female and male described by Mayr, and to consider all the other American forms as races or varieties of *brevicorne* till we have proof of the contrary."

After examining considerable material of STENAMMA from different parts of the United States, from Connecticut to Washington, I am able to establish the truth of Professor Forel's conjecture. Among this material a single male and female collected at Corvallis, Oregon, and sent me by Mr. J. C. Bradley, are without question referable to Mayr's *nearcticum*. These specimens are very dark, with conspicuous apterostigma, and with the same neuration as the European *westwoodi*, *i. e.*, the inner branch of the cubital vein comes off *at the cross-vein*. The males and females of all the other North American forms in my possession (including *diecki* Emery!) have the inner branch of the cubital vein arising *from the middle of the cubital cell*, and therefore undoubtedly belong to *brevicorne* Mayr, as Forel has conjectured. Emery was evidently puzzled by the sculpture of the postpetiole. This is rough and opaque in *brevicorne s. str.*, but smooth and shining in some of the subspecies, like *diecki*. As he had no winged specimens of this subspecies he was thus led to assign it to *westwoodi*.

The synonymy of the two species, as I understand it, should therefore stand as follows:

STENAMMA NEARCTICUM Mayr.

S. nearcticum Mayr, Verh. zool.-bot. gesell. Wien, 1886 p. 447. ♂ ♀ (nec ☿).
? *S. westwoodi* West. subsp. *nearcticum* Emery, Zool. jahrb. Abth. f. syst. bd. 8, 1894, p. 299, 300. ☿.
S. nearcticum Forel, Ann. Soc. ent. Belg., tom. 45, 1901, p. 347. ♂ ♀.

STENAMMA BREVICORNE Mayr.

Aphaenogaster brevicornis Mayr, Verh. zool.-bot. gesell. Wien, 1886, p. 447. ♀ ☿.
Stenamma nearcticum Mayr, ibid. p. 454 ☿ (nec ♂ et ♀).
S. brevicorne Emery, Zool. Jahrb. Abth. f. Syst. Bd. 8, 1894, p. 298. ♂ ♀ ☿.
S. westwoodi subsp. *diecki* Emery and var. *impressum* Emery, ibid. p. 300, 301.
S. brevicorne Forel subsp. *diecki*, var. *impressum*, and subsp. *impar* Forel, Ann. Soc. ent. Belg., t. 45, 1901, p. 347, 348.

I subjoin a table for the identification of the worker forms of *S. brevicorne*, so far as I am able to separate them. The construction of this table has been facilitated by the kindness of Professor Emery, who contributed to my collection types of *diecki* and a specimen of what he took to be the worker of *nearcticum*, both from Yale, British Columbia, and Professor Forel who generously sent me a type of *impar*.

STENAMMA BREVICORNE Mayr.

I. Head, thorax and pedicel opaque; the spaces between the rugae not sufficiently smooth to make the occiput and pronotum appear shining under a low magnification.

A. Larger forms (2.5–4 mm.). Body dark brown or nearly black, except the base and tip of the gaster which are yellow or reddish. Milwaukee (C. E. Brown); Rockford, Illinois (Wheeler); Beatty, Pennsylvania (Rev. P. J. Schmitt), Angora, Pa. (Schmitt); Friday Harbor, Washington, (Kincaid); Lyndon, Vermont (A. L. Melander); Virginia; Pennsylvania (Pergande) *brevicorne* (typical).

B. Smaller forms (2.4–3 mm.). Body brown or red; with a blackish band across the first gastric segment.

1. Sculpture finer than that of the typical *brevicorne*. Length 2.4–2.7 mm. Eye with at least six ommatidia in its greatest diameter. Epinotal spines well developed. Petiolar node more compressed anteroposteriorly

than in *brevicorne* typ. and in profile angular above. Mesoëpinotal depression very marked. Virginia (Forel, Pergande); Beatty, Pa. (Schmitt).
subsp. *impar* Forel.

2. Sculpture and color as in *impar*. Length 2.5–3 mm. Eye very small, with not more than three or four ommatidia in its greatest diameter. Mesoëpinotal depression shallower than in the preceding forms. Epinotal spines small. Petiolar node longer, lower and more rounded than in *impar*. St. Vincent, Pa. (Schmitt). . subsp. *schmittii*, subsp. nov.

II. Back of head, thorax and nodes of pedicel more or less shining, when seen under a low magnification, on account of the coarser rugosity and smoother interrugal spaces; sculpture of the pro- and mesonotum sharp and regular, the rugae straight in the middle and curving on the sides.

1. Length 2.75–3. mm. Color usually reddish brown. Mesoëpinotal depression moderate. Epinotal spines robust, only slightly directed upwards. Yale, B. C. (Emery); Beatty, Pa. (Schmitt); Colebrook, Conn. (Wheeler); Rockford, Ill. (Wheeler); Pacific Grove, Cal. (H. Heath).
subsp. *diecki* Emery.

2. Somewhat larger and darker brown, mesoëpinotal depression broad and deep. Epinotal spines very short, blunt and directed more upwards than in *diecki*. Head less shining behind and thoracic rugae coarser and less numerous. Rich Springs, N. Y. (Emery); Vermont (Forel)
var. *impressum* Emery.

A fine colony of the typical *brevicorne*, comprising all three phases was sent me by Mr. C. E. Brown, who found it under a stone at North Milwaukee, Wis., May 11th, 1901. At Rockford, Ill., I have taken several colonies of this form, rarely under stones, but most frequently under the thick layer of dead leaves and vegetable mould which accumulates in rich, damp woods. In this locality I did not see the winged sexes till July 25th–Aug. 19th. The early capture of these by Mr. Brown would seem to indicate that they sometimes pass the winter in a virgin state in the parental nest.

The colonies are always very small, comprising not more than 20–60 workers and very often even less. They resemble colonies of LEPTOTHORAX, especially when they are found, as is sometimes the case, nesting in hollow acorns embedded in the vegetable mould. The species is very timid, and apparently either nocturnal or subterranean in its habits. This seems to be indicated by the coloration, the small size of the eyes in the workers, and by the fact that I have never seen these insects moving about on the surface of the ground even on dark, cloudy days. They probably feed on small larvae and other animal food. *S. brevicorne*, like *S. nearcticum*, is a sub-boreal form and has not been found up to the present time in

the southern states. It does not even occur among the fine lot of ants kindly collected for me in the high mountains of New Mexico by Prof. and Mrs. T. D. A. Cockerell.

The subspecies *diecki* also occurs at Rockford under the dead leaves in the very same localities as the typical *brevicorne*. Often the nests of the two forms are located only a few feet from each other. The winged sexes of *diecki* are recorded in my notes as occurring from Aug. 15th–19th. They are decidedly smaller than the corresponding sexes of the typical form, and the male is paler, with colorless wings and paler legs and antennae. I could detect no differences in habits between *diecki* and the typical *brevicorne*.

AUSTIN, TEXAS,
April 25th, 1903.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLII.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Coniodes plumigeraria Hulst. A general account of the life history has been given by Coquillett, but without detailed descriptions. The species has been repeatedly bred at the Department of Agriculture. Eggs were received from Mr. E. M. Ehrhorn which were collected three miles above Saratoga, Santa Clara County, California, on an apple tree, and from these the life history was made out.

EGGS. Laid in a large mass on a twig on the flat sides. Elliptical, strongly flattened above and below, ends nearly alike, one only a little depressed. Surface minutely shagreened, somewhat transversely so, the reticulations nearly lost, elongate transversely, moderately uniform. Size .8 × .6 × .4 mm. Color dark bronzy brown.

STAGE I. Head rounded, bilobed, clypeus rather high; dull black, epistoma whitish; width about .3 mm. Body robust, rather short, normal, not tapered, segments somewhat angularly widened centrally. Black, a narrow yellowish white line on the sharp substigmatal fold, broken in the incisures; traces of geminate yellowish dorsal line in the incisures of central segments. Tubercles rather large, rounded, brown; setae distinct but not long, brownish; feet black.

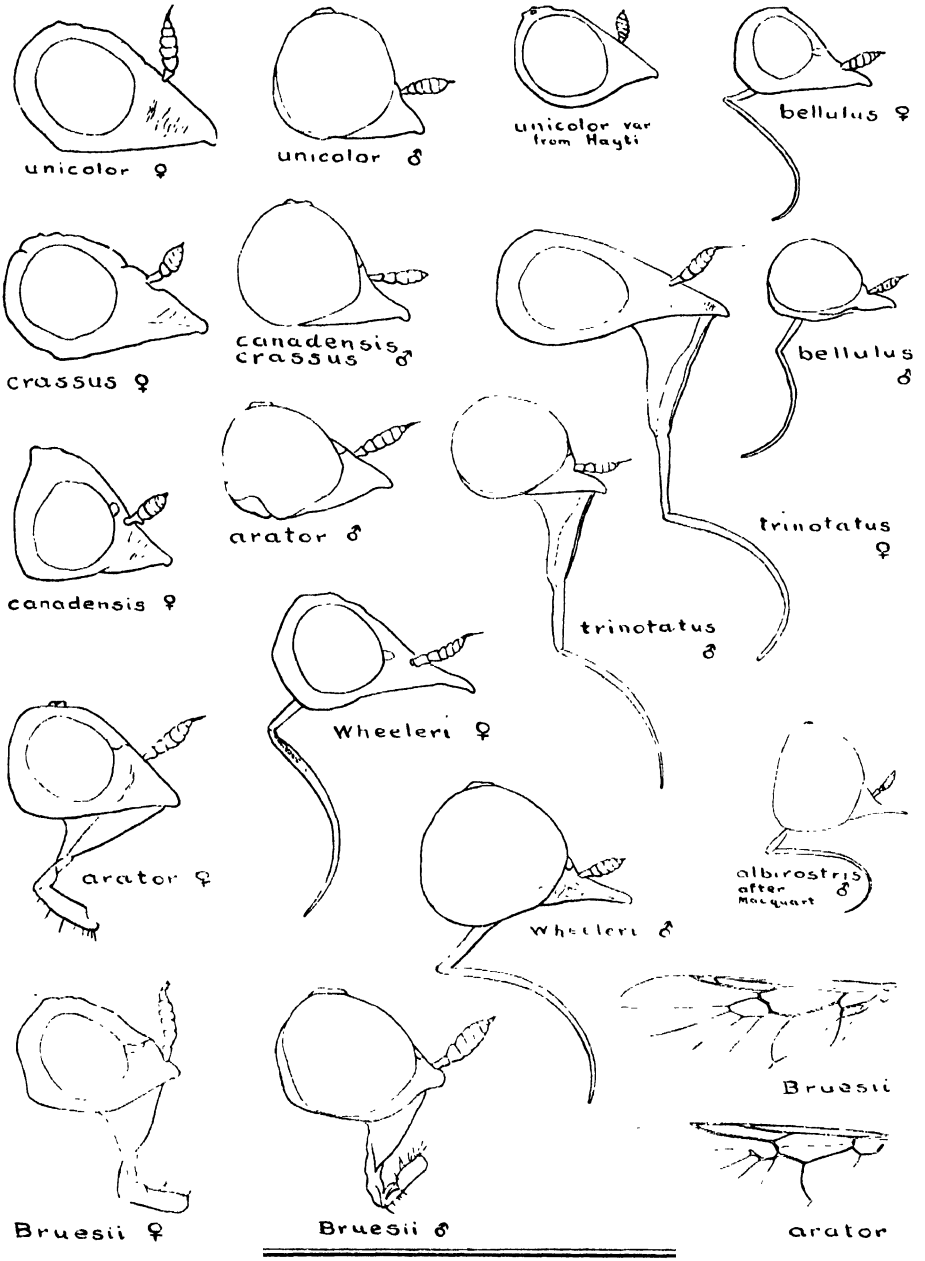
STAGE II. Head erect, rounded bilobed, thin anterio-posteriorly at vertex, brown-black, reticulate with darker, scarcely shining; width .5 mm. Body moderate, rather thick, segments annulate, tubercles large and produced but smooth, concolorous, rounded, not tapered, black. Body slaty black, dull; traces of a geminate white dorsal band in the incisures and a broad, diffusely white lined lateral area, ill defined. Feet all black; setae fine, dark, inconspicuous.

STAGE III. Head rounded, flat before, broadly shallowly bilobed; grayish, speckled with black, thickly so over the apex and in a patch on each side of clypeus above; a black patch at base of antennae; width .9 mm. Body cylindrical, moderate, normal, tubercle ii of joints 5 to 7 and 12 forming high cones, the rest elevated roundedly. Feet of joints 2 and 3 held appressed, those of joint 4 erected. Shining bronzy black with scarcely any marks. Traces of a whitish addorsal line and irregular pale areas stigmatally anteriorly, largest on joints 5 and 6 and traces of white dotted supra- and substigmatal lines. Feet all black; setae moderate, pointed, dark.

STAGE IV. Head squarely rounded, lobes separated by a wide low notch, flattened before, depressed at apex of clypeus; clypeus reaching two thirds to vertex, the paraclypeal pieces nearly reaching vertex; light gray with many irregular crinkled black spots irregularly vertically arranged on the sides and partly confluent behind the vertices of the lobes; sutures of mouth black marked; width 1.6 mm. Body cylindrical, normal, robust, not elongated; tubercles prominent, especially ii on the raised part of the abdomen and forming a stout cone on joint 12. Blackish, especially across the centers of the segments, a rather broad whitish addorsal line, broken and obscured centrally, rather distinct on the thorax and before tubercle ii on joint 12. Sides yellowish blotched, scarcely defining subdorsal, suprastigmatal, and two subventral lines which are irregularly traceable; a conspicuous black patch behind the spiracle on joints 6 and 7, slightly indicated on other segments. Venter blackish, pale medioventrally and between joints 10–13. Thoracic feet black, abdominal ones dark, the plates of joints 13 lighter. Cervical shield not developed. Tubercles black, single, normal, dark, pointed.

STAGE V. Head rounded squarish, scarcely bilobed, the vertical notch obsolescent, flattish before, the sutures at apex of clypeus depressed; surface shagreened; yellowish, mottled and spotted with brown, heaviest on sides of lobes and in clypeal depression; width 2.3 mm. Body normal, robust, tubercles roundedly produced, smooth, ii the largest, on joints 5 to 7 forming distinct cones, on 12 situated on a slight dorsal prominence, normal, iii to v closely surrounding the spiracle, two tubercles representing vi; no cervical shield, anal shields developed, triangular, but concolorous and not corneous. Skin minutely spinulose; spiracles large, black rimmed; setae distinct, dark. Varies from sordid gray to green without distinct lines or strong markings. There is a general indication of longitudinal lines, pale, marked with fine brown dottings. These lines are addorsal, subdorsal, suprastigmatal, and two subventral, but all are ill defined, especially the subventral ones. Feet pale.

PUPA. Cylindrical, normal, abdomen tapering, with three movable incisures; cremaster two stout spines joined at the base into a flattish plate; cases wrinkled; abdominal segments coarsely punctured. Length 18, width 5 mm.



MELANDER: — NEMOTELUS.

PSYCHE.

A REVIEW OF THE NORTH AMERICAN SPECIES OF NEMOTELUS. PLATE 4.

BY AXEL LEONARD MELANDER, CHICAGO, ILL.

The genus NEMOTELUS, or NEMATOTELUS, includes a group of rather small Stratiomyiidae generally of dark coloration, characterized by the prolongation of the lower part of the face. From the underside of this rostellum projects the slender and long drawn-out proboscis which has gained the generic name for these insects. However instead of being used as a weapon these mouth parts are admirably adapted for their function of feeding from the long throated florets of the cone-flowers. These small flies are not rare; where they occur they can be caught by dozens from the heads of their favorite flowers. From the few published records concerning this genus it would seem that in the Eastern States *N. carbonarius* is the most abundant. In Illinois *N. unicolor* is the prevailing form. This species also, has the greatest distribution, occurring to Hayti and Mexico. *Nemotelus canadensis* is commonest in Colorado, *N. crassus* in Kansas, while the Texas species are all equally abundant.

The European species of this genus have been divided into three groups by Dr. H. Loew, as follows: —

1. All the tibiae in part black,
2. Hind tibiae only in part black,
3. All the tibiae with almost no black.

On this basis the North American species would be grouped thus: —

1. *tristis*	1. *unicolor*	1. *pallipes*
2. *carneus*	2. *carbonarius*	2. *wheeleri*
3. *glaber*	3. *canadensis*	3. *acutirostris*
4. *slossonae*	4. *crassus*	4. *flavicornis*
5. *bellulus*	5. *arator*	5. *immaculatus*
	6. *bruesii*	6. *albirostris*
	7. *polyposus*	7. *trinotatus*

Of these groups the first seems incongruous, but the other two are well constructed. The species of the second have black males, stubby faces, and as a

whole occur inland. The third, however, is a maritime group. The males have white abdomens and the faces are produced and pointed. *Nemotelus pallipes* Say is an anomalous species of the group. It is interesting to note that apparently so trivial a character as the relative extent of the dark color on the tibiae should be correlated with much more striking differences. Another remarkable correlation was noticed for the species in the collection. Those with black males (*N. unicolor*, *crassus*, *carbonarius*, *canadensis*, and *arator*) have the third vein of the wings simple; those species whose males have whitish abdomens have the third vein furcate (*N. wheeleri*, *trinotatus*, and *bellulus*). *Nemotelus bruesii*, however, is anomalous in this as well as in other respects. With this division in mind Mr. C. W. Johnson was asked to furnish data from the types of his species. *Nemotelus immaculatus* is injured, but *N. slossonae* and *flavicornis* have the third vein simple. Although these species have the abdomen white, it is nevertheless marked with a blackish design. We shall look forward with interest for an account of this characteristic in the other species.

In the preparation of this paper I have had access to the Hough collection of the University of Chicago. My own material supplemented by specimens from Dr. Wm. M. Wheeler has been of the greatest use. In conclusion I wish to thank Mr. Charles W. Johnson of Boston for his assistance in furnishing literature not accessible in Chicago and for the information regarding the types of his species.

Key to the Species.

Males: eyes contiguous, or nearly so . . . . . 2.
Females: eyes widely separated . . . . . 17.

2. Abdomen entirely black, or black with whitish marks . . . 3.
   Abdomen whitish or whitish with black markings . . . . 11.
3. Antennae situated at the middle of the short and blunt rostellum; proboscis geniculate at its outer third, the outer part pilose; eyes contiguous and impressed along line of juncture; third vein furcate; black species with golden pubescence . . . . . *bruesii*, sp. n.
   Antennae situated at base of the longer and more acute rostellum 4.
4. Venter with a series of medial rufous spots; legs beyond base of femora yellowish; costal veins white; greenish black species . . *pallipes* Say
   Venter immaculate; hind legs at least in part blackened; third longitudinal vein simple . . . . . 5.
5. Body black, with no pale lateral markings on the thorax . . 6.
   Thorax with pale lateral markings . . . . . 8.

6. Body with purple tinge; hind tibiae black in the middle; tip of tarsi black . . . . . *polyposus* Say
   Body shining black, not purplish . . . . . 7.
7. Front immaculate; eyes subcontiguous; base and apex of hind tibiae pale; anterior tibiae subfuscous . . . . . *carbonarius* Loew
   Front bimaculate; base of all the tibiae pale . . . *tristis* Bigot
8. Pilose species with greenish luster . . . . . *arator*, sp. n.
   Bare or nearly so . . . . . 9.
9. Eyes contiguous; metallic blue-black; front spotted with white . . . . . *canadensis* Loew
   Eyes subcontiguous; front black . . . . . 10.
10. Shining black species . . . . . *nigrinus* Fallén
    unicolor Loew
    Shining blue-green species . . . . . *crassus* Loew
11. Abdomen with black dorsal markings; thorax black with a lateral line; third vein simple . . . . . 12.
    Abdomen wholly whitish, unspotted; third vein furcate . . 13.
12. Thorax greenish black; abdomen with two central black spots in the fourth and fifth segments; posterior femora and tibiae brown in the middle . . . . . *flavicornis* Johnson
    Thorax black; abdomen with a basal black mark also; legs largely black, tip of femora, base and tip of tibiae and tarsi whitish *slossonae* Johnson
13. Proboscis, geniculate at the middle, the basal part enlarged; lateral line of thorax obsolete, humeral spot small . . . . . 14.
    Proboscis geniculate before the middle . . . . . 15.
14. Legs yellow; antennae yellow, proboscis red . . *immaculatus* Johnson
    Femora at least blackened; antennae black; proboscis black . . . . . *trinotatus*, sp. n.
15. Face comparatively short, black; thorax shining, pubescence rather erect; eyes depressed along line of meeting . . . . . *bellulus*, sp. n.
    Face longer, yellowish above . . . . . 16.
16. Length 3 mm.; antennae yellow except tip; thorax greenish; front linear . . . . . *albirostris* Macquart
    Length 5 mm.; antennae blackish; thorax slaty black, subshining, with appressed pubescence; eyes contiguous, not depressed along line of meeting . . . . . *wheeleri*, sp. n.
17. Abdomen above with whitish lines or spots; third vein furcate 18.
    Abdomen above wholly black; third vein not branched (except *bruesii*) 21.
18. Markings of abdomen arranged in a median series of triangular spots; head

long conical flattened, antennae inserted midway between the eyes and the tip of the rostellum; proboscis geniculate at the middle *trinotatus*, sp. n.

Markings of abdomen arranged in a double series; head in profile more or less hollowed out at the antennae; proboscis geniculate before the middle 19.

19. Abdomen with whitish markings beneath, at least in the middle: face very long and sharp, frequently paler above; thorax shining; 3 mm. *acutirostris* Loew

Abdomen black beneath; if the face is long the thorax is not shining 20.

20. Thorax granular, subshining, sparsely pubescent; facial projection long, acute; humeral mark small, frontal spots punctiform . . . *wheeleri*, sp. n.

Thorax polished, nearly bare; face short, black; humeral mark large; frontal spots transverse . . . . . *bellulus*, sp. n.

21. With a whitish spot on each side of the front above the antennae . 22.

With no whitish spot on the front . . . . . 25.

22. Facial projection shorter than width of eye; antennae inserted near its tip; lateral line of thorax obsolete . . . . . *bruesii*, sp. n.

Facial projection equal to width of eye, antennae inserted near its base 23.

23. Lateral line of thorax well defined . . . . . 24.

Lateral line of thorax obsolete . . . . . *tristis* Bigot

24. Head and thorax nearly bare, subaenescent . . . *canadensis* Loew

Head and thorax moderately pilose, with a greenish tinge . *arator*, sp. n.

25. Sides of thorax with a yellowish line . . . . . 27.

Sides of thorax not marked; black shining species . . . . 26.

26. Anterior tibiae subfuscous, hind ones black except extreme tip and base *carbonarius* Loew

All the tibiae vittate with black . . . . . *carneus* Walker

27. All the femora and tibiae black; thorax with a greenish tinge *glaber* Loew

Front and middle tibiae rather yellowish . . . . . 28.

28. Blue-green species . . . . . 29.

Black, shining species . . . . . *nigrinus* Fallén

unicolor Loew

29. Facial projection longer than width of eye . . *crassus* Loew

Facial projection shorter than diameter of eye . . . *unicolor*, var.

DESCRIPTIONS OF THE SPECIES.

1. NEMOTELUS CRASSUS Loew.

Nemotelus crassus Loew, Cent. Amer. Diptera, iii, 10. (1)
Williston, Can. ent., 1885, vol. 17, p. 128. (2)
Johnson, List ins. N. J., p. 639. (3)

Female. Stout, of a greenish black somewhat metallic color, front not spotted, antennae black, the tip of the second joint yellowish, a lateral line of the thorax, the knees, the front tibiae, and all the tarsi pale yellowish. Length of body $2\frac{1}{2}$ lines (4.2 mm.), length of wing 2 lines (4 mm.).

Rather stout, bare, highly shining, greenish black, the color of the anterior part of the front and of the face merging to bluish rather than green. Front broad, immaculate. Antennae black, the tip of the second joint brownish or yellowish. Face produced into a rather large sharp cone. Lateral line of the thorax very slender, pale yellowish. Femora black, the tip, however, yellowish; the whole of the front tibiae and the broad base and narrow tip of the hinder ones yellowish, the intervening portion black; tarsi pale yellowish. Halteres white. Wings whitish, the thinner veins similar, the thicker ones very pale yellowish, submarginal cell of an opaque color. (*Translation.*)

Rhode Island (1); Kansas (2); New Jersey (3).

Profile of head of male and female figured on plate.

2. NEMOTELUS CANADENSIS Loew.

Nemotelus canadensis Loew, Cent., iii, 12. (1)

Male and *female.* Clothed with short whitish hairs, shining, greenish black, submetallic, antennae black, the lateral line of the thorax very narrow, the tip of the femora, the tibiae except a median ring around the hind ones, and the tarsi yellowish.

Male. Eyes contiguous, frontal triangle yellowish, face drawn out.

Female. Front broad, on each side with a yellowish spot, sometimes faintly marked, face acute.

Length of body 2–$2\frac{1}{2}$ lines (4.–4.2 mm.), length of wing 2 lines (4 mm.).

Clothed with short and fine whitish hair, shining, greenish black, somewhat metallic. Head concolorous. Eyes of male contiguous, eyes of female separated on the broad front. The anterior frontal triangle of the male pale yellow above, the front of the female marked on each side with a pale yellow spot. Face of male produced into a moderately prolonged cone, of the female into a subacute one. Lateral line of the thorax whitish yellow, very fine. Abdomen margined with a dirty yellow narrow line sometimes obsolete. Femora black, yellow at the tip; tibiae yellow, the hind ones annulate with a black ring; tarsi yellow, the last joints frequently infuscated or blackened. Halteres white. Wings whitish, the stronger veins pale yellowish, the submarginal cell often of the same color. (*Translation.*)

Hudson Bay Territory, Fort Resolution, (Kennicott.) [1]; Colorado, (Hough collection, C. F. Baker).

Profile of head of male and female figured on plate.

3. Nemotelus unicolor Loew.

Nemotelus unicolor Loew, Cent., iii, 11. [1]
Williston, Can. ent., 1885, p. 128. [2]
Williston, Biologia Centr.-Amer., Suppl. p. 251. [3]
Nemotelus nigrinus Fallén, v. d. Wulp, Tijdschr. entom., 1867, p. 126. [4]

Female. Bare, shining, black, antennae concolorous, front immaculate, a very slender lateral line on the thorax yellowish, femora black except the yellowish tip, anterior tibiae subfuscous, hind ones black, the base and extreme apex of all yellowish. Length of body 1¾ lines (3.5 mm.), length of wing 1⅔ lines (3.3 mm.).

Bare, shining, black. Front immaculate. Antennae black. Face produced into a rather large and sharp cone. Lateral line of the thorax pale yellow, very thin. The hind tibiae and the femora black, the tip of the latter and the base and apex of the former yellowish; anterior tibiae subfuscous, with the base broadly and apex narrowly yellowish, sometimes wholly pale yellowish; the last two joints of the yellowish tarsi sometimes infuscated. Halteres whitish. Wings whitish, the stronger veins very pale yellowish. (*Translation.*)

Illinois, (Le Baron) [1]; Wisconsin [4]; Pennsylvania, Arizona [2]; Tabasco, Mexico. [3]

The male which has not been described before is similar to the female. The outline of the head is naturally different as represented on the plate. The thorax is sometimes decidedly pubescent with very fine whitish hair. Halteres often blackened.

Profile of head of male and female figured on plate.

This is the commonest species in Illinois: Chicago, Glen Ellyn, Algonquin, McHenry are the localities from which I have specimens. May to September. One female from Glen Ellyn has the facial prominence shorter than the head, the antennae reddish beneath and the knob of the halteres blackish. All the other females examined have a longer face, black antennae, and white halteres. Is not *N. unicolor* the form referred by van der Wulp to *nigrinus* Fallén? The descriptions of the European species apply very well to the North American specimens.

A single specimen in the Hough collection taken in Hayti seems closely related to *N. unicolor*. Were it not for the extended distribution of this species and the fact that the Glen Ellyn specimen of *unicolor* represents a similar variation, the West Indian example might be considered another species. Its peculiarities are the following: thorax with a black bronzed tinge; antennae brownish basally; face short, in length less than the width of the eye; length 2.25 mm. See figure. The specimen scarcely seems to be the female of any of the three species occurring within its geographical range. (*N. immaculatus, slossonae, flavicornis.*)

4. NEMOTELUS CARBONARIUS Loew.

Numotelus carbonarius Loew, Cent., viii, 6. (1)

Johnson, List ins. New Jersey, p. 639. (2)

Male and female. Bare, black, shining, antennae concolorous, front immaculate, no lateral line on the thorax, femora black except the yellowish tip, anterior tibiae subfuscous, hind ones black, base and extreme tip of all yellowish.

Very much like *Nemotelus unicolor*, but different in its smaller size and in possessing no pale line on the side of the thorax. Halteres subfuscous. Eyes of the male subcontiguous. (*Translation.*)

Length of body 1 lines (3.3 mm.), length of wing $1\frac{7}{12}$ lines.
Lenox, Massachusetts, (Osten Sacken) (1); New Jersey (2).

5. NEMOTELUS TRISTIS Bigot.

Nemotelus tristis Bigot, Ann. soc. ent. France (6), vii, 1887, p. 30. (1)

Male. Face produced as a cone. Black over all, shining; two whitish spots above the antennae, halteres white, knees, base of the tibiae, and the tarsi except the tip pale fulvous; wings hyaline, the strong veins at the base pale yellow.

Female. Very much the same.

Male. Face prolonged in a sharp cone, at least equal to the length of the head. Entirely shining black, two white spots situated above the base of the antennae; halteres with white knob; extremity of the femora, the knees, base of the tibiae and of the tarsi, of a very pale reddish; wings absolutely hyaline, except that the external veins are lightly tinged with yellow. (*Translation.*)

Length 4 mm.
California. (1)

6. NEMOTELUS GLABER Loew.

Nemotelus glaber Loew, Cent., x, 10. (1)

Female. Bare, shining, black, dorsum of the thorax and the scutellum faintly greenish, front immaculate, thorax with a very fine whitish lateral line, femora and tibiae black, tarsi white, the last two joints of the front ones and the last joint of the hinder ones fuscous, knob of the halteres black above.

Bare, shining, black. Front broad, unspotted. Antennae brownish black, towards the base dull red. Face produced into a rather stout acute cone. Dorsum of the thorax and the scutellum obsoletely green from a black ground color; the lateral line of the thorax very fine, whitish. Legs black, the knees dull whitish and the tarsi white, but the last two joints of the front ones and the last joint of the others fuscous. Halteres whitish, the knob black above. Wings whitish, the stronger veins very pale, the rest completely uncolored. (*Translation.*)

Length of body $1\frac{2}{3}$–$1\frac{3}{4}$ lines, length of wing 1 $\frac{1}{4}$ –$1\frac{2}{3}$ lines.
Texas, Belfrage. (1)

7. NEMOTELUS CARNEUS Walker.

Nemotelus carneus Walker, Barnston's MSS, List dipt. ins., 3, p. 521. (1)

Female. Black, antennae black, legs yellowish, femora black, tibiae striped with black, wings whitish. (*Translation.*)

Body black, shining; head a little narrower than the chest; eyes piceous; mouth and feelers black; scutcheon unarmed; abdomen much broader, but not longer than the chest; legs tawny; hips and thighs black; tips of thighs tawny; shanks striped with black; wings whitish; wing-ribs tawny; veins and poisers pale yellow.

Length of body 1½ lines (3 mm.) of the wings 3 lines.
St. Martin's Falls, Albany River, Hudson Bay, (G. Barnston). (1)

8. NEMOTELUS PALLIPES Say.

Nemotelus pallipes Say, Journ. acad. nat. sci. Phila., vol. 3, 29. (1)
Ed. Lec., vol. 2, p. 52. (2)
Wiedemann, Auss. zweifl. ins., ii, 45, 2. (3)

Male. Greenish black, thorax tinged with green; nervures white.

Rostelliform process blued black; polished; antennae brown, at the base of the rostelliform process; front with a triangular white spot above the antennae; thorax punctured, a testaceous line before the wings and another each side on basal edge; poisers and scale pure yellowish white; costal nervure whitish; feet yellowish, base of thighs and middle of posterior edges of the segments of the venter rufous.

Length $\frac{3}{20}$ inch (3.8 mm.).
Pennsylvania. (1, 2, 3)

9. NEMOTELUS POLYPOSUS Say.

Nemotelus polyposus Say, Journ. acad. nat. sci. Phila., vol. 6, 160. (1)
Ed. Lec., vol. 2, 356. (2)
Williston, Biol. Centr.-Amer. Dipt. Suppl., 251. (3)

Male. Black, feet yellowish; thighs black at base.

Body black, with slight tinge of purplish, polished; wings white; costal and basal nervures yellowish; poisers white; feet honey yellow; thighs except at tip black; tarsi with the terminal joint black; posterior tibiae black in the middle; venter immaculate.

Length not more than $\frac{3}{20}$ inch (3.7 mm.).
Mexico (1, 2); Mexico City. (3)

10. NEMOTELUS ARATOR, sp. nov.

Female. Olivaceous black, shining, densely pilose with fine dusky yellow hair; head with two transverse yellow spots above the antennae; vertex rounded into the front and on the occiput, facial projection conical, stout, subacute, moderately long, equaling the width of the eye, antennae black, inserted one third the distance out from the frontal spots; proboscis short, fleshy, geniculate at the outer third, the outer part hairy beneath. Thorax without a humeral macule, but with a pale lateral line. Abdomen concolorous with head and thorax, inornate. Femora black, except the knees, hind tibiae blackened in the middle, tarsi infuscated apically. Halteres yellow, the pedicel black. Wings whitish hyaline, the anterior veins testaceous, third vein unbranched, fourth posterior vein arising from base of discal cell.

Male. More pilose, with a more bluish reflection. Frontal spots small, contiguous, eyes contiguous for a short distance only, where they are impressed, facial protuberance much reduced, the antennae arising from its base, proboscis short. Otherwise similar to the female.

Length 4.5–5 mm.

Described from one male and one female from a larger lot of the same species collected by Dr. Wm. M. Wheeler, March 1897, in San Diego Co., California.

Profile of head of male and female and figure of wing illustrated on plate.

11. NEMOTELUS BRUESII, sp. nov.

Female. Black, closely covered with short appressed coarse silvery pubescence. Head short rounded conical; face short, two thirds the diameter of the eye, antennae inserted near the tip of the face, rather long, especially the first two joints, black, arista thick, bristly at tip; front with two narrow transverse white spots, proboscis short, but little longer than the length of the head, geniculate at its outer third, the outer part fleshy and hairy. Thorax with a small humeral spot; lateral line obsolete. Abdomen unmarked. Femora black except tip, tibiae darkened at middle, especially the hind ones, remainder of legs testaceous. Halteres blackened. Wings hyaline, the stronger veins testaceous, third vein furcate before its end; the fourth posterior vein arising at the basal third of the under side of the discal cell.

Male differs in the fine golden pubescence; face stubby, eyes scarcely touching; frontal spots triangular, subcontiguous.

Length 4 mm.

Described from numerous specimens collected by myself and by Mr. Charles T. Brues, my constant fellow-worker, during our stay at the University of Texas, Austin, Texas. This species is abundant during middle April, and shows special partiality for the flowers of *Lepachys columnaris*, the entire collection being made from the flowers growing on the University campus. The species is soon succeeded in the local fauna by *N. trinotatus*.

Profile of head of male and female and arrangement of venation figured on plate.

12. NEMOTELUS TRINOTATUS, sp. nov.

Female. Head long, flat from the tip to the strongly declivous occiput, conical, rather acute, no distinction between front and facial protuberance; totally black, shining, pubescence short appressed sericeous golden, moderately sparse; antennae black, inserted midway between eyes and tip of face; proboscis long, black, geniculate at the middle, the basal half membranous behind, the outer half curved. Thorax black with a very faint greenish tinge, its pubescence like that of the head but denser laterally, humeral mark small, lateral line very narrow. Abdomen black, not greenish, shining, bare, the first segment yellowish in front, the spot broadest medially, second, third, and fourth segments each with a median triangular white mark broadest posteriorly, that of the fourth segment continuous with the yellow hind margin, the entire abdomen margined with a white line broadest caudally and becoming attenuated toward the base of the abdomen; venter black shining, sparsely pubescent, immaculate but with a narrow whitish outline. The markings of the first two segments of abdomen sometimes obliterated. Femora black except the yellowish tip, posterior tibiae blackish in the middle merging into yellow at the base and apex, tarsi light yellow. Halteres white. Wings white, veins concolorous, third vein furcate at tip, fourth posterior vein arising at basal third of underside of the rather large discal cell.

Male differs from the female as follows: facial protuberance shorter and more slender, front with two contiguous white spots, antennae inserted at the base of the protuberance; eyes contiguous and slightly impressed along the line of contiguity. Hairs of thorax less sericeous, silvery. Abdomen wholly white. Hind tibiae with a black spot.

Length ♂ 3.5 mm.; ♀ 4.5 mm.

Described from numerous specimens of both sexes collected during May and June at Austin, Texas, by Mr. C. T. Brues and the writer. The species was abundant during the first weeks of June on the flowers of SAPINDUS, the "wild chinaberry tree."

Profile of head of male and female figured on plate.

13. NEMOTELUS FLAVICORNIS Johnson.

Nemotelus flavicornis Johnson, Proc. acad. nat. sci. Phila., 1894, p. 272. (1)

Male. Face and vertical triangle black, shining. Facial protuberance prominent, conical; antennae yellow. Facets of the upper half of the eye double the size of those of the lower. Thorax and scutellum greenish black, shining; humeri, and a narrow line from there to the base of the wings, yellow. Abdomen yellow, with a small black subtriangular spot in the center of the fourth and fifth segments; venter yellow. Legs yellow, posterior femora and tibiae with a medial band of dark brown. Wings hyaline, whitish, discal cell emits four veins.

Length 2½ mm.

Kingston, Jamaica. (1)

Mr. Johnson writes that the third vein is simple.

14. NEMOTELUS SLOSSONAE Johnson.

Nemotelus slossonae Johnson, Proc. acad. nat. sci. Phila., 1895, p. 304. (1)

Male. Face and vertical triangle black, shining; facial protuberance very prominent, conical; frontal triangle brown. The upper portion of the eye with large facets brown, the lower third with small facets blackish; antennae dark brown. Thorax and scutellum black, shining; a narrow, light yellow lateral line extends from the humerus to the posterior angle. Abdomen yellowish white; a central mark on the first segment below the scutellum, a dorsal triangle and a small spot near the lateral margin of the fourth, and the fifth except a narrow lateral and posterior margin black; in one specimen there is a minute brown dot near the anterior angle of the third segment. Venter whitish. Legs black; tip of the femora, base and tip of the tibiae, and the tarsi whitish; wings hyaline, whitish; discal cell emits four veins.

Length 3 mm.

Charlotte Harbor, Florida. March. (Mrs. Annie Trumbull Slosson.) (1)

This species also has the third longitudinal vein simple. (C. W. Johnson, *in litt.*)

15. NEMOTELUS ACUTIROSTRIS Loew.

Nemotelus acutirostris Loew, Cent, iii, 13. (1)

Female. Black, shining, clothed with fine whitish hairs, front marked on each side with a white spot, face produced into a very long and sharp cone, the lateral line of the thorax, the margin of the abdomen, and three pairs of spots white, legs whitish, basal half of the femora black. Length of body 1½ lines (3 mm.), length of wing same.

Black, shining, clothed with short and fine white hair. Head concolorous, front marked on each side with a white dot, face produced into a very long and sharp cone, often fuscous above. Antennae black, the first two joints fuscous, rarely yellowish. A humeral spot and a very slender lateral line on the thorax white. Margin of the abdomen white, the second, third, and fourth segments each marked with two long white spots contiguous on the hind margin. Venter often white, sometimes the lateral border and the last segments wholly brown or blackish. Legs whitish, the femora often black except the tip, sometimes also at the base dull whitish, posterior tibiae except the base and tip frequently darkened. Wings whitish, the stronger veins pale yellowish. (*Translation.*)

Cuba, Gundlach. (1)

16. NEMOTELUS IMMACULATUS Johnson.

Nemotelus immaculatus Johnson, Proc. acad. nat. sci. Phila., 1895, p. 304. (1)

Male. Face and vertical triangle blackish; eyes of a dull brown color (probably much lighter than in the living specimen); antennae yellow; proboscis red, unusually long, with an acute angle, the two portions thus formed being of almost equal length, the outer half is

curved downward and the basal part of the other is somewhat enlarged. Thorax black, with sparse whitish pubescence most prominent on the pleurae; scutellum black; abdomen greenish white, immaculate. Legs light yellow; wings hyaline, whitish.

Length 4 mm.

St. Augustine, Florida (F. H. Genung). (1)

17. NEMOTELUS ALBIROSTRIS Macquart.

Nemotelus albirostris Macquart, Dipt. exot. Suppl. 4, p. 359; Tab. 3, fig. 8. (1)

Male. Thorax black; abdomen white.

Rostellum a little longer and more drawn out than in *N. pantherinus;* white above, black beneath; proboscis slender and elongate. Front linear. Antennae inserted at the base of the rostellum, yellow, the end of the third joint brown. Thorax black with a green reflection. Abdomen white. Femora black the tip white; tibiae and tarsi white. Halteres white. Wings hyaline. (*Translation.*)

1½ lines (3 mm.).

Virginia (M. Bigot). (1)

The "linear front" probably means that the eyes are subcontiguous as in the males of some of the other species.

Profile of head, redrawn from Macquart's illustration, figured on plate.

18. NEMOTELUS WHEELERI, sp. nov.

Male. Head comparatively flattened; rostellum slender, long, yellowish above; antennae fuscous, style slender; two triangular contiguous yellow spots in the frontal triangle; eyes contiguous, not depressed medially, the lower facets small; proboscis twice the length of the head, slender, chitinous, reflexed, geniculate at the basal third. Thorax black, subshining beneath, with short appressed yellow scaly pubescence; humeri and a narrow lateral line pale yellow; pleurae similar; halteres white. Abdomen flat, white over all. Basal three fourths of the femora black merging into the white knees, remainder of legs yellowish. Wings and veins hyaline, third vein furcate, fourth posterior arising near middle of underside of discal cell.

Female. This sex differs from the male as follows: head conical, one half longer than high, occiput flattened; the broad front minutely scabrous, with two rounded spots at the margin of the eye. Abdomen black, except for a paired medial series of transversely elliptical yellowish spots on the posterior margin of the first four segments, the last pair connected with the yellow margin circumscribing the entire abdomen; genitalia yellow; venter blackish, margined with yellow.

Length 4–5 mm.

This pretty little species was secured during the first weeks of June, 1900, at Galveston, Texas, being attracted to an undetermined Composite growing profusely

near the Medical college of the University of Texas. It gives me much pleasure to dedicate this to my instructor, Dr. William Morton Wheeler, who assisted in the capture of these specimens.

Profile of head of male and female figured on plate.

19. NEMOTELUS BELLULUS, sp. nov.

Male. Head globose; rostellum short, black; antennae black, style slender; frontal triangle yellow; eyes contiguous and slightly depressed along their line of meeting, the lower facets not much smaller; proboscis slender, reflexed, chitinous, black, less than twice as long as the head, geniculate at the basal fourth, the outer part strongly curved. Thorax shining black, clothed with fine silvery pubescence; the large humeral spot and a narrow lateral line whitish; pleurae more sparsely pubescent. Abdomen entirely white. Femora black on basal three-fourths, the knees whitish; tibiae black except tips; tarsi yellowish. Halteres white. Wings and veins hyaline, the costal veins, however, yellow, third vein furcate, fourth posterior vein arising near middle of underside of discal cell.

Female differs from the male in the shape of the head and coloration of the abdomen. Head roundedly conical, in profile slightly excavated above; the frontal white spots transversely lengthened. Thoracic pubescence not so fine. Abdomen black with a double series of narrow transverse yellow spots on the posterior margin of the first four segments; the side margin of the first six segments very narrowly yellowish, terminal segments infuscated; venter black, the posterior and side margins of the individual segments very narrowly yellowish.

Length 3–4 mm.

Described from a number of specimens collected at Galveston, Texas, June, 1900.

Profile of head of male and female figured on plate.

HULL ZOOLOGICAL LABORATORY,
University of Chicago.

DESCRIPTIONS OF THREE NEW DIPTERA OF THE GENUS PHTHIRIA.

BY CHARLES W. JOHNSON, BOSTON, MASS.

PHTHIRIA CYANOCEPS, sp. nov.

♂ Front, face, and occiput light bluish gray, ocellar triangle black; first and second joints of the antennae light yellow, third joint black, and about twice the length of the first and second joints combined; proboscis black, nearly double the length of the head. Thorax bluish gray (becoming blackish when dampened); scutellum light yellow. First and second segments of the abdomen black, with a sharply defined, narrow, posterior margin of yellow on the first segment; posterior margin of the second and all of the remaining segments, widely margined with grayish white, leaving a narrow, blackish, basal band, the segments are often so contrasted in dried specimens that the dark anterior portion is more or less concealed. Halteres white. Legs light yellow, tip of the metatarsi and all the other joints of the tarsi black. Wings whitish hyaline.

♀ Front and vertex broad, yellowish, occiput more prominent than in the male; ocelli, a small spot above the base of the antennae, and a short line on the occiput extending toward the cervix, on each side of a median depression, black, the first abdominal segment black, the others brownish, and all widely margined posteriorly with yellow. Length, 1.5 mm.

Four males and one female were collected by Mr. Owen Bryant and myself, on September 8th, by sweeping over the scanty vegetation on a white sandy tract near the beach at Cohasset, Mass. The eyes are a brilliant blue when living, changing to purple after death, and to dark brown when dry. It is the smallest of our described species. Types in the New England collection of the Boston society of natural history.

PHTHIRIA ALDRICHI, sp. nov.

♂ Face, ocellar triangle, and occiput grayish white, frontal triangle yellowish; face and occiput bearing conspicuous white pile; first and second joints of the antennae yellow, third black and about double the length of the other two; proboscis black and more than twice the length of the head. Thorax grayish white, sparsely covered with whitish hairs (in damp or greasy specimens the thorax is black); scutellum, postalar processes, and a spot between the base of the wing and halteres yellow. Abdominal segments blackish widely margined posteriorly with yellow, the black being most prominent on the second segment, genitalia and venter yellow. Legs variable in color, usually brownish black, with the base and tip of the femora and the base of the tibiae and metatarsi more or less yellowish. Halteres white, wings whitish hyaline.

♀ Front and face yellow, cellar triangle and a short line on the occiput, on each side of the median depression, black. Humeri, lateral margins, upper portion of the pleurae, postalar

processes, and scutellum yellow. Abdomen yellowish, the dark basal portions being brown, and entirely wanting on the last four segments. Legs yellow, with only the tips of the tibiae and metatarsi and all the tarsi brown or blackish. Length, 4 mm.

Described from three males and one female received from Prof. J. M. Aldrich, who says: — "I collected it on a white sand bar along the Boise river at Caldwell, Idaho, June 24, 1901. It is very pale in life, and flies just like the drifting of the sand, close down and a short distance at a time. It is a fine instance of protective coloration. The male has beautiful purple eyes in life."

PHTHIRIA QUINQUENOTATA, sp. nov.

♀ Front, face, and occiput grayish white, with short white pile; antennae and proboscis black. Thorax grayish white, sparsely covered with white hairs; dorsum with five large, velvety black spots arranged as follows: — one on each side just above the humeri, and three just back of the transverse suture; two slender black dorsal lines extend anteriorly from the central spot, and there is also a very small dot above the base of the wing; scutellum grayish white and quite thickly covered with white hairs, base narrowly margined with black; metanotum black, abdomen covered with a whitish pubescence through which the black ground color is visible; yellow posterior margin of the first segment broad, on the others very narrow. Legs black, tips of the femora and base of the tibiae and middle metatarsi yellow; on the middle and hind tibiae there is an obsolete brownish band near the base, with a broader yellowish band above. Wings whitish hyaline, veins yellow. Length, 4 mm.

One specimen from Grand Junction, Colorado, received from Prof. C. P. Gillette.

THE RE-DISCOVERY OF PHILORUS (BLEPHAROCERA) YOSEMITE OSTEN SACKEN.

BY VERNON L. KELLOGG, STANFORD UNIVERSITY, CAL.

About 3 P. M. on June 6, 1876, Baron von Osten Sacken caught three flying male Blepharocerid flies "on the bridle-path to the foot of the Upper Yosemite Fall." From these specimens he described the new species *Blepharocera yosemite*, and since that time no further records of the capture of representatives of the species have been made. This last summer, while tramping and climbing in the Sierra Nevadas, I took occasion to visit the "bridle-path to the foot of the Upper Yosemite Fall" with Osten Sacken's twenty-five years gone capture in mind, but there were no delicate-winged *B. yosemite* hovering by the path side. About sixty-miles farther south, however, in another great Californian flat-floored, vertical walled gorge, the Grand Canyon of the King's River, I found the larvae and pupae of a Blepharocerid species new to me, which prove, on dissection of the well formed adults from the pupal cases, to be the immature stages of Osten Sacken's Yosemite species. I have before me males and females (taken from the pupal cases), larvae and pupae, so another gap in our knowledge of the Blepharocerid fauna is filled in.

These larvae and pupae were taken July 15, 1903, from the smooth, submerged surfaces of great granite blocks fallen into a swift little clear-water stream called Granite Creek, from a vertical cliff-side lifting three thousand feet above. In the relation of their home stream to the great mountains, in all their environment, they might as well have been in the Yosemite Valley in the stream which falls 1600 feet over a cliff's verge to make the Upper Yosemite Fall. The two great canyons, that of the Merced (the Yosemite) and that of the King's, have the same relative relation to the main crest of the Sierra Nevada, the same altitude, the same conditions of temperature and moisture, the same geology and botany and zoology.

The imagines (dissected from pupal cases) show exactly the characteristic venation as described by Osten Sacken, which I have taken to be diagnostic of the genus *Philorus* (see my "Net-winged Midges of North America," No. XXX of Contrib. to biol. from the Hopkins seaside laboratory, 1903).

As Osten Sacken had no female specimen and thus could not say whether the separated and dissected eyes of the male were characteristic of both sexes I record here the fact that in the female the eyes are broadly separated and also distinctly bisected (that is, divided by a line into an upper, light brown part, being about $\frac{2}{5}$ of the whole eye, composed of large ommatidia, and a lower, blackish brown part composed of smaller ommatidia).

The pupae differ from those of all other Blepharocerid species known to me in having the dorsal prothoracic respiratory flaps contiguous; they are distinctly apart in all other known pupae. The larvae more nearly resemble those of *Bibiocephala comstocki Kell.* (a species common in the Santa Cruz Mountains of the San Francisco peninsula) than those of any other species, having the lateral processes in much the same condition. They differ noticeably, however, in being much darker and without spots on the dorsum.

I add, in closing this note, two records of Blepharocerid distribution which are not included in my monograph of February (referred to above). Professor Cockerell has taken *Bibiocephala grandis* in New Mexico, and Professor Aldrich *Bibiocephala elegantulus* in Idaho.

TWO COCCIDS FROM SAMOA.— While in the Samoan Islands during the summer of 1902 (on the Samoan Explorations expedition of the U. S. bureau of fisheries) I collected two well-known species of scale insects which I note are not recorded in Mrs. Fernald's catalogue from these islands. These two Coccids are *Coccus* (*Lecanium*) *hesperidum*, found abundantly at Apia (Upolu island) on oranges (the orange in the South Seas has its ripe fruit green in color and very small); and *Hemichionaspis aspidistrae* found on the "ti" plant, *Cordyline terminalis*, at Pago-Pago (Tutuila Island). The "ti" is that widely distributed native plant of the Pacific Islands whose leaves will be remembered by visitors to Honolulu as the attractive fresh green wrapping "paper" used by the dealers in the great fish market.— *Vernon L. Kellogg.*

AMORY LELAND BABCOCK, born Nov. 15, 1826, died Feb. 27, 1903, at Sherborn, Mass. Mr. Babcock was throughout a long and active life an enthusiastic collector of natural history specimens, devoting his energies chiefly to forming an extensive private collection of animals and curios from every quarter of the globe. Attracted strongly by the beauty of birds and butterflies he directed his energies chiefly to these groups, especially in his earlier years. Accompanied by his wife he spent several months in the winter of 1872–3 in British Guiana, collecting in the vicinity of Georgetown and among the Indian villages of the interior along the Essequibo river. The winter of 1879-80 was spent in a similar trip to Florida.

During later years he had devoted his time chiefly to insects and by collecting and exchanges had secured a large amount of material. Of the local fauna he had paid most attention in these later years to the Odonata, and several collections are the richer for his efforts in this direction. *Enallagma pictum* was described from material in his collection and the types were donated by him to the Museum of comparative zoölogy.

Mr. Babcock, while hampered exceedingly by lack of means and early advantages, possessed energy, enthusiasm, and perseverance to a notable degree, and a lover of nature was always sure of his interest and encouragement. It is to be hoped that his collection may remain intact as a fitting monument to his untiring efforts and singleness of aim.— *Albert P. Morse.*

THE TIPULID HYPOPYGIUM, A STUDY IN SPECIFIC ADAPTATIONS.

BY ROBERT E. SNODGRASS, STANFORD UNIVERSITY, CAL.

A detailed study of the terminal abdominal segments of the males and females of the Tipulidae shows an enormous amount of variety in the hypopygial parts of the males, and, in striking contrast, a uniform simplicity of structure in the corresponding parts of the females. The writer has made such a study on a large number of Tipulid species in the entomological collection of the Washington Agricultural College, identified by Mr. R. W. Doane. The detailed descriptions and figures are comprised in two papers not yet published, but some facts of general interest are here given.

The term "hypopygium" may be most conveniently limited to the ninth abdominal segment of the male. This is the genital segment, *i. e.*, the one that in all insects carries the intromittent organ and usually the clasping appendages.

The Tipulid hypopygium is in general cup-shaped with the opening posterior. The cavity of the cup is the *genital chamber* and is produced simply by the invagination of the posterior face of the segment. This necessarily carries into the genital chamber the tenth or anal segment which, morphologically, terminates the abdomen. Attached to the posterior rim of the hypopygium are, on each side, from one to three clasping lobes, called the *apical appendages*. The body of the segment is composed of four plates — one dorsal, one ventral, and two lateral. The dorsal and ventral plates are evidently the tergum and sternum respectively, while the lateral ones may be termed the pleural plates on account of their position. In the lower genera they have strictly a pleural position, but in the higher genera they may be simply set into the posterior rim of the segment, or exserted upon the posterior margin, or they may be lacking entirely. They always, however, when present, bear the apical appendages. According to the structure of the pleura the relationships of the larger groups within the family and the evolution of the genera from one another may be nicely traced.

Within the genital chamber and arising from its floor or anterior wall lies the penis, a straight or curved rod-like tube. Its terminal part is always protected by a chitinous guard arising from the posterior part of the floor of the genital chamber.

Now, although the larger groups within the family are separable on a basis of modifications in the more fundamental parts of the hypopygium, the other parts, such as the apical lobes, the penis, and the guard of the penis, present an infinite number of specific variations. No two species, no matter how similar otherwise, were found to be even nearly identical in the structure of these parts.

Turning now to the females we find less variety in the terminal parts of the abdomen throughout the entire family than may characterize the males of one genus. The female parts are constructed as follows: The eighth sternum is prolonged far back of the eighth tergum, and is terminated by two elongate appendages set on edge beside each other. The ninth segment is much smaller in diameter than the eighth, and consists of a narrow ring of chitin. The tenth segment is generally elongate and terminates in two usually long and tapering cerci. The dorsal side of the eighth sternum is concave and the concavity is covered above by the ventral parts of the ninth and tenth segments. Rudimentary gonapophyses are present in the form of small plates or bars of chitin on the upper side of the eighth sternum and on the opposed ventral side of the ninth.

Within the group Tipulina the female genital parts differ almost exclusively in the form of the rudimentary gonapophyseal plates, and usually only the tips of these project as free processes. On the other hand, the modifications of the male parts within this group are excessive. Within the other groups the genera are characterized by slightly varying shapes of the external female parts, but in none is there any variety comparable with that existing between the males.

In other words, it is impossible to point out any correlation between the great variations of the male hypopygia and the extremely slight modifications of the female genitalia. How, then, are we to explain the origin of the former? If the modifications in the structure of the body of the hypopygium, the varieties in size and shape of the guard of the penis and the clasping apical appendages are not adaptive, why do they exist? The conclusion seems to be unavoidable that some other cause for specific variety must be operative here than that of adaptation to the female organs. That the more fundamental modifications of the hypopygium had an early origin in the evolution of the family is evinced by the fact that they are characteristic of the larger groups into which the family has been separated on other characters.

It is such a common method of explanation in the case of specific variations such as one meets with in these Tipulid hypopygia, to assume that they are adaptive, that it is interesting to see how such explanations may fail to be substantiated when tests are actually made. It can, of course, be said that our knowledge of the physiology of the parts is insufficient, and that on this account nicely balanced interrelations are not perceived. A failure to disprove, however, is not a proof of the opposite, and no one can ever say of anything that his knowledge of it is complete.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE. — XLIII.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Metrocampa praegrandaria Guenée.

Egg. Elliptical, thick, one diameter less, evenly rounded, the ends nearly alike, no depression or truncation. Laid in small groups, erect on the antemicropylar end, strongly adherent. Reticulations regularly hexagonal, small, narrow, obscure, not raised; on the large sides there is an indication of ribbing in that the reticulations are more longitudinally placed; ends smoother. Yellow, turning red. Size .8 × .6 × .55 mm. Hatched in 11 days.

Stage I. Head round, bilobed, pale brown, sutures darker; width about .4 mm. Body short, rather robust, subventral fold widened a little segmentarily. Pale yellowish, a broad dorsal, narrow linear subdorsal and substigmatal dark red lines; a row of subventral red spots on joints 5 to 9. The lines do not quite reach the ends and are somewhat broken in the annulet folds. Cervical shield large, but concolorous. Tubercles small, brownish. Setae distinct, pale, moderate, scarcely enlarged at the tips. Abdominal feet on joints 10 and 13 only.

Stage II. Head bilobed, luteous, immaculate; width .6 mm. Body moderate, pale green, dorsal line broad, subdorsal narrow, lateral clouded, substigmatal and traces of subventral lines all vinous brown, the latter three obscurely joined by large clouded patches on joints 5 to 9. Feet pale; tubercles obsolete; setae short, obscure.

Stage III. Head rounded, bilobed, dull luteous with distinct brown dots behind the eyes and faint ones in the vertical suture; width .9 mm. Body moderate, uniform, segments irregularly annulate; yellow luteous, dorsal line narrow, dark brown, broadly edged with light brown, subdorsal and lateral lines dark brown, the latter joined by large segmentary spots to upper and lower subventral lines, shaded on joints 10–13. Feet pale; tubercles small, slightly raised; setae short, dusky.

Stage IV. Head pale greenish brown, finely dotted with dark over the lobes except a streak on the vertex of each; width 1.2 mm. Body moderately elongate, feet of joints 10 and 13 remote and a small pair of feet on joint 9, the feet approximate; segments wrinkly, irregularly annulate, uniform, smooth. Olivaceous yellowish, shaded with brown. Dorsal line dark brown in a lighter brown cloud; subdorsal, lateral, and stigmatal lines narrow, light, indicated by clouded brown edges; a distinct substigmatal line and subventral spots of dark brown. Feet pale, the anal ones projecting laterally. Tubercles concolorous, with dark hair dots; setae fine, pale; in the subventral region some pale secondary root-like prominences are mixed with the longer setae of tubercles vi and vii. (These prominences are not present in stage III and the extra feet are barely indicated.) The intersegment of joints 7–8 is more darkly shaded; dorsal tubercles more or less brown marked. The larvae rest flat on the bark.

Stage V. Head bilobed, thick, greenish white with numerous angular black spots composed of dots which are larger in a curved band from ocelli to before vertex, framing the face; width 1.8 mm. Body moderate, flattened ventrally, with a series of white rootlets along the subventral edge; feet on joints 9, 10, and 13, those of joint 9 small, but used. Bark brown, wrinkly, dorsal line dark, subdorsal, lateral and two subventral lines pale, fine, all obscure; subdorsal dark intersegmental blotches, especially centrally, darkest on the intersegment

7-8. Venter pale; no secondary hairs, the primary ones of tubercle vii scattered among the rootlets. Feet all pale greenish.

Spun a slight cocoon. One moth emerged the same season, but most hibernated in the pupal stage, making the species normally single brooded. Larvae from Kaslo, British Columbia; they fed on the leaves of white birch.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLIV.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Mesoleuca gratulata Walker.

Egg. Elliptical, thick, the antemicropylar end strongly depressed, top and bottom concavely flattened medially, micropylar end flattened. Rather coarsely wrinkly shagreened all over except on the side of attachment, no reticulations. Uniformly pale yellow. Size .8 × .7 × .5 mm.

Stage I. Head cordate, black, the color diluted centrally, the pointed mouth brown. Body normal, moderately elongated; all pale yellow, tubercles small, blackish, a little raised; cervical shield dusky luteous, obscure; setae distinct, rather long, dusky, glandular tipped.

Stage II. Head bilobed, pale yellow, eye black, mouth brown. Body moderate, green, roughened by the tubercles and annulets, translucent, unmarked; tubercles slightly raised, concolorous; feet green; setae pale, distinct; feet of joints 10 and 13 rather remote.

Stage III. Head rather long, slightly bilobed, pale testaceous, eye black, mouth brown; width .9 mm. Body translucent green, no shields, a narrow, broken, white subdorsal line, a faint white shade each side of the dorsal vessel, a narrow, waved lateral line and subventral fold whitish. Tubercles large, elevated, smooth, concolorous, shining. Setae rather long, pale, curved; spiracles black edged.

Stage IV. Head rounded, bilobed, lobes full, clypeus moderate; green, shining; eye black, jaws brown; width 1.3 mm. Body not elongate, the central segments not much longer than wide, cylindrical, subventral fold prominent, roughened by the tubercles. Green, intersegmental folds yellowish; a waved subdorsal line, narrow lateral one, and substigmatal line white, dull, obscure. Tubercles white, curved backward. Spiracles black; feet pale.

Larva from Kaslo, British Columbia.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLV.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Hydriomene magnoliata Guenée. My specimen agrees more nearly with Hulst's type of *Hydriomene pernotata* Hulst than with some eastern specimens

of *Coenocalpe magnoliata;* but I do not see any specific difference between these two forms. Dr. Hulst placed them in separate genera, but he differentiates these genera only in that HYDRIOMENE has the thorax tufted posteriorly while COENOCALPE is not so. Now several *C. magnoliata* from Maine, New York, and New Jersey before me have fully as large thoracic tufts as Hulst's type of *H. pernotata*, and some of these specimens have been labeled *C. magnoliata* for me by Dr. Hulst. Therefore I would transfer *C. magnoliata* to HYDRIOMENE and place *H. pernotata* Hulst as a synonym of it. Henry Edwards is credited with a description of the larva in Proc. Cal. acad. sci., feeding on FUCHSIA GERANIUM, etc.

Egg. Rounded elliptical, flattening marked but rounded, micropylar end truncate, narrower than the center, the other end depressed. Reticulations roundedly hexagonal, low, rounded, distinct, becoming larger at the truncated end, finely granular shagreened all over; cell areas distinctly hollowed; pale yellow. Size .8 × .6 × .4 mm.

Stage I. Head rounded, full, clypeus high; pale luteous, faintly brownish spotted on the tubercles, ocelli black. Body moderate, normal, pale whitish, unmarked. Tubercles small, dusky; setae moderate, pale, glandular tipped. Segments irregularly wrinkled annulate; no shields; feet pale.

Stage II. Head scarcely bilobed, erect, whitish with faint dusky spots on the sides of the lobes, ocelli black; width .6 mm. Body moderate, whitish, green from the food except at the end, a narrow diffuse dusky green dorsal line; tracheal line white. Tubercles concolorous, obscure; setae short, black. A barely indicated pale subdorsal line; feet pale.

Stage III. Head rounded, the apex in joint 2 green, freckled with purplish; width .85 mm. Body moderate, slender, smooth green; subdorsal, lateral, and stigmatal lines greenish white, hardly contrasted; dorsal vessel dark, marked on joints 11 and 12 with purple brown. Feet pale; tubercles obsolete; setae short, dark. A little purple shading on the foot of joint 10.

Stage IV. Head rounded, bilobed, often held flat; green, finely brown freckled over the vertex, mouth white; width 1.5 mm. Body moderate, rather slender, segments wrinkled posteriorly. Green, white shaded, dorsal vessel green; subdorsal line white, not contrasted, subventral fold whitish. Thoracic feet faintly brownish; a purple band on the foot of joint 10 edged with white, a white line on the anal foot; a dorsal purple band on joints 12 and 13. Tubercles small, round, white, elevated; setae short, black. Some of the larvae became suffused with reddish dots bordering the pale lines or the subventral fold broadly pink shaded.

The larvae fed upon fire weed (*Epilobium angustifolium*), which seems to be their natural food plant. Larvae from Kaslo, British Columbia.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLVI.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Hydriomene multiferata Walker.

Egg. Roundedly elliptical, truncation, flattenings, and depression distinct, but all rounded; evenly, smoothly reticulate with rather broad, slightly raised lines forming rounded hexagonal cells; pale yellow. Size .6 × .5 × .4 mm.

Stage I. Head rounded bilobed, erect, clypeus high and broad; yellowish whitish with large smoky brown dots on the tubercles; setae dusky. Body elongate and very slender looking, finely annulate, pale yellow; dorsal and subdorsal purple brown lines, varying in width, streaked on the annulets. The long central segments are double, composed of an elongate small intersegmental portion and a larger central one bearing the setae. On the intersegmental subsegments are traces of an addorsal line which curves outwardly distinctly on joint 11. Broken, streaked lateral, subventral and adventral lines; no shields; setae short, of the shape of bulbs with short stems; tubercles brown.

Stage II. Head pale whitish dotted with brown; tubercles blackish; width .5 mm. Body slender, elongate; green from the food, the lines red brown, pulverulent; dorsal line straight, addorsal represented by traces, subdorsal and lateral broken, substigmatal nearly continuous, subventral and ventral broken; feet pale; setae short; tubercles minute, obscure.

Stage III. Head round, full at sides, whitish with black dots on the faces of the lobes; width .9 mm. Body slender, pale green from the food, dorsal line narrow, fluctuating, brown black, divaricate on joint 2, absent on the anal plate; faint traces of lateral, suprastigmatal, and substigmatal lines on central segments. No shields; tubercles concolorous; setae short black, capitate.

Stage IV. Head rounded, slightly elongate, clypeus depressed, oblique; whitish, opaquely translucent, a broad brown shade on the angle of the lobe, the pair converging to the vertex; antennae pale, ocelli black; width 1.4 mm. Body slender, elongate, central segments over twice as long as wide, the intersegmental portion slenderer, ends shrunken, abdominal feet approximate. Soft green, a little white shaded; cervical shield yellowish with brown blotches and from it a broad dorsal band runs backward, rapidly narrowing and vanishing on joint 5; a brown dash on joint 12 and 13 anteriorly. A narrow, nearly invisible white subdorsal line. Annulet incisures a little clearer. Tubercles obsolete, setae short, dark. Thoracic feet reddish. The dorsal band may run the whole length except on the anterior half of joint 9.

The larvae formed pendent cocoons of earth attached to a leaf. Standing on a leaf they reached bits of earth which they spun about themselves with a soft web, beginning around the anal feet. The cocoon forms a loose bag of web covered with dirt hanging from the leaf. The fire weed was preferred as a food plant. Larvae from Kaslo, British Columbia.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLVII.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Hydriomene excurvata Grote.

Egg. Elliptical, flattened, depression well marked, cuneiform from side view, the other end rounded, scarcely truncate; reticulations irregularly hexagonal, neat, distinct, moderately broad, low raised, cell areas flat. Pale yellow, shining. Size .8 × .6 × .5 mm. Laid singly, adherent.

Stage I. Head rounded, sordid smoky shaded, pale at the mouth, the eye black, prominent. Body moderate, normal, sordid gray from within, dark granular on a whitish ground; no marks; no shields; tubercles small, but the setae distinct, rather long with swollen, club-shaped tips.

Stage II. Head strongly bilobed, thickly mottled with dark brown, the paler ground color hardly showing, ocelli black; width .4 mm. Body moderate, normal, sordid luteous, obliquely striped in dark brown; the stripes start in an intersegmental dorsal patch, edged by whitish, run obliquely forward to join a submacular subventral zigzag shade; a geminate ventral band. Setae dark with clear swollen tips. Ordinary lines obsolete, a pale geminate dorsal and subdorsal indicated.

Stage III. Head strongly bilobed, thickly mottled in dark brown with a pale streak on the apex of each lobe; width .6 mm. Body moderate, the segments annulate, tubercles elevated, setae short and pale with swollen tips. Pale luteous, heavily obliquely striped with blackish brown, starting from strong intersegmental spots, forward and downward, joining, or nearly so, a series of reversed subventral stripes. An adventral shaded band and slight narrow dorsal and subdorsal ones. Thoracic feet brown; abdominal ones pale on the outside.

Stage IV. Head rounded, bent downward, gray black with a bright white streak before the apex of each lobe and another above the eyes; width .95 mm. Body moderate, thicker behind, the segments a little widened on the subventral fold, finely annulate; latticed in dark brown and pale yellow; a narrow dorsal brown line in a brownish yellow ground, enclosed by a series of diamond-shaped brown marks, shaded and obscure toward the thorax, on joints 11 and 12 represented by only the posterior half of the marking; a series of broad lateral shades run obliquely posteriorly and shade into a broad, adventral dark brown band. Tubercles pale, hair dots dark; setae short, dark, capitate, the tubercles somewhat elevated. No shields.

Stage V. Head rounded bilobed, rather sharply so, sordid gray brown, an obscure pale streak on the vertex of the lobe; width 1.2 mm. Body thick, robust, stick-like, straight, the thorax a little smaller, the segments irregularly annulate, skin finely granular. Anterior half of larva darkly shaded, the posterior half light yellowish dorsally; oblique black brown lines as before, obscured anteriorly, joining a subdorsal blackish waved line; a dorsal line, slightly broken intersegmentally, then obsolete, on joints 11 and 12 the marking represented only by subdorsal dots. Venter dark, leaving a pale ventral line. Tubercles small, slightly elevated; setae short, black, subcapitate. A broad, bright, pale yellow bar on joint 2 subdorsally. Feet of joint 10 light outwardly.

Eggs were obtained as early as July 5th when the moths had only just begun to fly, but all the larvae hibernated. Many were very small, only a few reached the fifth stage in the autumn. They were fed on POLYGONUM, but are probably rather general feeders on low vegetation at the ground. The coloration is adapted both for concealment in such a situation and for hibernation at any stage after the first. Larvae from Kaslo, British Columbia.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—XLVIII.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Deilinia erythremaria Guenée. My adults agree with Vancouver Island specimens, called *Deilinia pacificaria* Packard. I do not think that the form is specifically distinct from the Atlantic coast *D. erythremaria* Guen. The slightly larger size and very slightly more distinct markings do not seem to justify more than a racial distinction. In Bulletin 52, U. S. nat. mus., Dr. Hulst credited the European *D. exanthemata* Scop. to "Canada." If this is correct, I would refer both *D. pacificaria* and *D. erythremaria* as varieties of the European species, though I think it is more probable that the European form does not occur in America at all. The European larva is described as entirely green or with pale dorsal lines.

Egg. Elliptical, strongly compressed but without flattened areas, depression marked, truncation broad and sharp edged; reticulations linear wavy longitudinal lines, 9 or 10 visible on the flat side, raised, finely waved, in one place two confluent, projecting at the rim of the truncation, confused at the other end. Cross-striae fine, distinct, forming elongate rectangular cells; truncation nearly smooth, obscurely reticulate, concave, raised at the micropyle. Color dull bluish green. Size .8 × .6 × .4 mm.

Stage I. Head rounded, depressed at clypeus, pale orange, shining. Body slender, normal, rapidly looping. Pale yellowish with dorsal and subventral red brown lines the whole length, narrowed just at the ends. No shields; feet pale. Tubercles moderately large, not elevated, setae minutely capitate.

Stage II. Head flattened, rounded, held flatly; whitish with a blackish band behind ocelli and a faint vertical one, both continuing lines of the body. Width about .5 mm. Body slender, elongate, whitish, appearing green throughout from the food. A distinct black brown dorsal stripe from joint 2 anteriorly to 13, fading on the anal flap; a similar stigmatal line. Feet pale. Setae very short with the tubercles not visible.

Stage III. Head rounded bilobed, flattish but the lobes full, oblique; pale luteous green, not shining; a dark mark in the vertical suture and a heavy brown side band behind the ocelli of brown black; width .8 mm. Body rather slender, translucent green from the food, not shining, not annulate. Dorsal and subventral stripes blackish brown, moderately broad, even, sharp, covering the outside of the feet of joints 10 and 13. Thoracic feet pale; tubercles and setae invisible; no shield.

Stage IV. Head rounded, flattened, especially towards the mouth, apex rather full, held flat; clear green, a brown black stripe from ocelli; antennae and jaws black; width 1.3 mm. Body moderate, smooth, clear green; a dorsal series of brown black segmentary spots obsoletely connected by a shade; a trace of a white subdorsal line especially posteriorly; substigmatal band brown black, segmentarily widened, covering the foot of joint 10 and a line on that of 13. Thoracic feet green. A median ventral whitish line segmentarily widened. Tubercles invisible; setae short dark.

Stage V. Head rounded, slightly bilobed, held obliquely flat; translucent green, not shining; clypeal sutures narrowly deepened; pale green; antennae and a stripe on side red brown; width 2 mm. Body moderate, cylindrical, normal; no shields; smooth, tubercles obsolete, setae minute, dark. Green; a diffuse white subdorsal stripe, faint on joints 2 and 13; a white addorsal patch centrally on the segments, divided by a black dash and surrounded except anteriorly by blackish powdering on joints 5 to 9, faint, however, on 5 and 9. A series of subventral brown black patches, obsoletely connected by a faint vinous shade, forming a line on the thorax and staining darkly the foot of joint 10 and the anterior side of the foot of 13. Subventral tubercles black marked; traces of lateral and stigmatal whitish lines, faint and obscure.

Larvae from Kaslo, British Columbia. They feed on willow.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE. — XLIX.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Deilinia pulveraria Hulst. One of Hulst's types before me from Rossland, British Columbia, agrees well with my Kaslo specimens, from which this life history was made out.

Egg. Laid very slightly adherent, detached at a touch. Rather full and rounded, flattening showing only as a less diameter, depression only at extreme end of egg but there marked, truncation marked, distinctly oblique. Over 20 longitudinal ribs, 9 visible on the broad side, sharp and high from a flat surface, narrow, compressed, slightly waved, ending at the edge of the truncation where they project like spines seen in profile view. Cross-striae low, distinct lines forming quadrangular cell areas and vertical lines on the ribs. The central pair of ribs join near the antemicropylar end. A line half way to the micropyle on the truncated end forms a row of cuneiform cells; micropyle reticulate. Color pale yellow, turning red. Size .8 × .4 × .3 mm.

Stage I. Head small, bilobed, pale luteous, shining, eye black, mouth brown. Body slender, motion rapidly looping and vibrant; translucent whitish; a straight, rather broad purple brown dorsal band the whole length and a similar lateral one. No shields; tubercles minute, dark; setae small, obscure. Later green in color but the bands unchanged.

Stage II. Head pale creamy whitish, a mottled black band on the side behind the eyes; antennae black; a few dots at vertex; setae black, stiff; width .6 mm. Body moderate, normal, slender, green, smooth, no shields, setae stiff, black. A dorsal blackish band present.

faintly shadowed or obsolete, but leaving a series of elliptical segmentary spots on the anterior edges of joints 5 to 11; broad subdorsal and narrow waved lateral white lines faintly pigmented, only a trace of a stigmatal line; subventral black shade broken and dotted, but distinct. Feet pale; tubercles whitish with black hair dots.

Stage III. Head white, heavily black mottled and dotted over the vertex, a brown band back from the antennae, edged by black dottings; width 1.1 mm. Body moderate, not elongate, smooth, green. A dorsal geminate, pulverulent, black line, partly broken centrally on the segments, heavier at the ends and with scattered attributary dots in the dorsal space. Subdorsal line pale, greenish white; a faint waved lateral line, olivaceous edged above. Subventral region broadly blackish shaded. Hair dots black; spiracles black ringed; no shields, setae small, dark. Later all shaded with brown in dense crinkled lines, leaving narrow addorsal, broad subdorsal, narrow upper and lower lateral, subventral and broad medio-ventral bands of pale. Dorsal black intersegmentary spots.

Stage IV. Head rounded, flat before, oblique, the apex in joint 2. Ground color gray whitish on face, yellowish over lobes, heavily checkered with black especially in a band each side of the clypeus which converge to apex; clypeus dark reticulate; width 1.6 mm. Body moderate, flatly extended on a twig, colored like bark. Ground whitish and ocherous brown, checkered with black; dorsal line shaded, broken, pulverulent, forming patches at the anterior and posterior ends of the segments, with addorsal spots at tubercle i, making a lattice work. A quadrate black subdorsal patch breaking the yellowish subdorsal line behind tubercle ii. Sides heavily black shaded except around the spiracles. Lateral and substigmatal lines faintly traced; subventral line (tubercle vii) rather broad and whitish. Tubercles black; tubercle iv with white specks around it; spiracles pale.

Larvae from Kaslo, British Columbia. They fed on CEANOTHUS. The cocoon was spun at the ground of silk.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—I.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Deilinia behrensaria Hulst. Most of the female specimens are *D. behrensaria*, the males are all *D. cervinicolor*. This is almost a constant sexual difference. The varietal name seems scarcely warranted in any case.

Egg. Elliptical, neatly rounded, smaller in dorso-ventral diameter but not flattened; truncate end flat, neatly rounded, the other end depressed. Over 20 ribs running lengthwise, straight from the depressed end to the angle of the truncation, 9 visible on the broad side, sharp, rather high, narrow, gently waved, joined by low but distinct linear cross-striae forming rectangular cells about twice as wide as long. A distinct line runs around the edge of the truncation and another half way to the micropyle, the ribs in crossing these form somewhat cuneiform cells; micropyle confusedly reticulate. Color pale yellow, later irregularly spotted with red. Size .8 × .7 × .5 mm.

Stage I. Head smooth, pale testaceous, eye black, mouth brown. Body moderate, yel-

lowish, shields concolorous; shaded with smoky blackish between the pale lines which are subdorsal, broken lateral, stigmatal and narrow subventral. Tubercles small, blackish in pale rings; setae black, stiff. Feet normal, not strongly plated. Later the color becomes green, a broad purple brown subventral band between the stigmatal and subventral white lines; joint 2 in front faintly testaceous.

Stage II. Head whitish, thickly dotted with black in a patch on sides of lobes and one on vertex; rounded, held obliquely; width about .6 mm. Body moderately elongate, ends contracted, normal. Whitish with green tint; traces of brown intersegmental dorsal line; broad subdorsal and stigmatal and narrow wavy lateral white lines, not very bright. A broad brown black subventral band a little interrupted anteriorly and weakened about the thoracic feet. Feet pale, tubercles black.

Stage III. Head white, thickly dotted with purple and black on vertex and patches on sides, held obliquely, antennae distinct, black spotted, width .9 mm. Body moderate, a little flattened, flatly outstretched, anal feet narrowly triangular, divergent. Green, addorsal white dots edging the dorsal vessel; subdorsal line white, not rigid, narrow, waved; sides besides irregularly streaked in white. Tubercles black, ii the largest; anal feet black powdered; setae black; no shields.

Stage IV. Head purplish white, the upper half white, thickly mottled and spotted in black; tubercles black, antennae white, black spotted; width 1.1 to 1.3 mm. Body held flatly extended, anal feet square behind, colored like bark. Gray brown, black dotted reticulate; dorsal line geminate, black, crinkly, tubercles i and ii black, just above the white subdorsal line which is slightly black edged above. A faint white lateral line, black edged. Tubercles black, iv conspicuously so and surrounded by white, the remains of a substigmatal band which appears also as a dash on the anterior parts of the segments. Feet pale waxy white.

Stage V. Head rounded, the lobes slightly squared, flat before; purplish, speckled thickly with pale ocherous and black, black on the vertex and a curved band edging the disk of face; epistoma and bases of antennae whitish, tips of antennae ocherous; width 1.8 mm. Body equal, a little flattened, held flatly, feet moderate. Ocherous brown, speckled with black; broken subdorsal dots, dots at tubercles i, iii, and iv bright white; white triangular marks on anterior edges of segments 6 to 9 and less bright ones on 5 and 10, edged behind with black shading which runs back in an irregular geminate dorsal line, distinct on the thorax and joints 10–13. A heavy black lateral shade looped down segmentarily below the spiracles. Thoracic feet pale, abdominal ones purplish mottled with white. Tubercles small, black, elevated slightly. A series of black ventral marks anteriorly on the segments composed of a double arrow-shaped streak joined into a blunt X-mark, more or less continued over subventral area to the lateral black marks.

Pupation among leaves. Larvae from Kaslo, British Columbia. They fed on CEANOTHUS.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.—LI.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Deilinia litaria Hulst. The specimens before me vary greatly; so much so that I am certain there will ultimately appear a considerable synonymy of this species. But I describe the larvae as *D. litaria*, as one of my specimens closely matches Hulst's type before me. The female moth is smaller than the male; both vary greatly in color and markings.

Egg. Elliptical with dorso-ventral flattening, micropylar truncation and depression normal, rounded, the truncation sharp and a little oblique. Coarsely quadrangularly reticulate, the longitudinal lines stronger than the transverse ones, forming apparent ribs, which are irregular, decreasing by confluence towards the ends and on the narrowing of the sides; raised, sharp, the cell areas flat on the bottom. A rather strong line borders the truncation which is strongly reticulate. Color pale yellow, turning red. Size .6 × .4 × .3 mm.

Stage I. Head bilobed, pale testaceous, eye dark, mouth brown. Body slender, looping, vibrant; all pale yellowish, translucent, the food showing green. Very faintly indicated brown dorsal and subventral bands. Feet pale; tubercles and setae small, invisible,

Stage II. Head flattened, scarcely bilobed, mouth large, projecting; luteous, eye black, mouth brown; width about .5 mm. Body moderate, normal, translucent yellowish, the folded incisures more opaque, appearing brighter. Setae short, stiff, black, distinct, from minute tubercles; no markings.

Stage III. Head pale green, not shining, epistoma and antennae whitish, setae black; width .7 mm. Body rather slender, green; broad dorsal and subventral blackish olivaceous shaded bands edged by very faint subdorsal and stigmatal whitish lines. Setae black, short, pointed; tubercles minute. Feet pale; no shields.

Stage IV. Head bilobed, the clypeus depressed, oblique; green, setae black; width 1.2 mm. Body rather short, slender, sides roughened by coarse annulets. Green, dorsal line obscure, blackish, pulverulent, obscurely geminate, forming heavier dots on the anterior edges of segments 7 to 10. Subdorsal line yellowish white, narrow, obscure; a faint waved lateral line. The tracheal line shows yellowish white. Setae short, black, tubercles invisible; feet green; no shields. Another larva was brown, all shaded with smoky blackish, heaviest subventrally; tubercles black.

Stage V. Green form. Head rounded, oblique, apex in joint 2; green, sparsely blackish freckled, a faint yellowish shade upon angle of lobe; epistoma pale, antennae reddish; width 1.6 to 1.8 mm. Body moderate, smooth, bright green; a distinct white subdorsal stripe, crinkled edged, on joints 2 to 13; a narrow broken white addorsal line, edging the darker dorsal vessel, with blackish marks on joints 3 and 4; traces of a wavy lateral line; feet green; spiracles faintly reddish, black rimmed; no subventral marks. Tubercles and setae obscure, dark; hair dots black. *Brown form.* Head gray, heavily black checkered. Body gray, black checkered, alternating black lines and quadrate patches, dorsally and subdorsally; a partly broken narrow white subdorsal line. Sides with four black lines including a broken white lateral line; substigmatal line white; subventer heavily black shaded. Feet very pale, contrasted; anal plate and feet greenish.

Pupation in the ground. Larvae from Kaslo, British Columbia. They fed on CEANOTHUS.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE.— LII.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Deilinia rectifascia Hulst. I have Hulst's unique type, a female. A second female from the same place (Easton, Washington: Koebele) was named *Cymatophora rectifascia* by Dr. Hulst. A third female from Oregon (Koebele) was, however, named *Deilinia falcataria;* but this is, I think, erroneous. A male from Rossland, B. C., does not show a fovea below on the fore wings while it does on the hind wings and it would therefore seem that the species, while a good one, should be placed in DEILINIA rather than in CYMATOPHORA. Hulst had no male in writing his original description, which would render his generic reference uncertain.

Eggs. Laid weakly attached, some falling loose. Elliptical, wedge shaped in side view, flattenings not marked; truncation distinct, rounded. A series of low ribs running to the truncated rim, about 10 visible on the broad side, joined by fine cross-striae, forming elongate rectangular cells, the whole ill defined and dim, not very sharply raised yet considerably so; all minutely frosted shagreened; truncation convex, reticular. Color pale yellow, turning red. Size .8 × .5 .4 mm.

Stage I. Head rounded, pale luteous, a darker shade over vertex, eye black, mouth brown. Body slender, pale whitish, a dark red dorsal and lateral stripe on joints 2 to 13. Tubercles and setae minute; feet pale; no shields.

Stage II. Head slightly bilobed, oblique; whitish, a brown shade over vertex and a band below ocelli; width .55 mm. Body moderate, yellowish white; broad dorsal and subventral dark brown bands, even, straight, reaching the ends, but not staining the feet. Tubercles minute, black; setae short, fine; feet pale; no shields.

Stage III. Head rounded, clypeus and sutures slightly depressed; pale yellowish, brown shaded and mottled over the lobes; antennae, jaws, and a band behind eyes dark; ocelli black; width .8 mm. Body moderate, green from the food; dorsal band broad, blackish brown, diluted with greenish, showing small intersegmental black dashes and edged by a faint, pale, subdorsal line. Subventral band present, broken into shaded patches, or obsolete. Tubercles invisible; setae short, black; feet pale; a double stigmatal obscure pale line.

Stage IV. Head as before; width 1.15 mm. Body green; a faint yellowish subdorsal line; a series of small brown dorsal intersegmental spots, confluent on the thorax, approximate by contraction on joints 12–13; a white adventral line. Feet pale; setae black.

Stage V. Head round, scarcely bilobed, lobes full; green on face, vertex red brown, a pale yellow band on lobe above, running to ocelli, with brown again below it, antennae long, light red; width 1.6 mm. Body moderate, uniform, anal feet spread triangularly; segments slightly folded annulate. Light green, opaque, a series of dorsal intersegmental patches of red brown mixed with yellowish, on thorax and joints 10–13 forming a nearly continuous band. Foot of joint 10 brown; of 13 brown behind. Thoracic feet green; tubercles small, dark, in pale rings; setae dark; venter white subpruniose.

Larvae from Kaslo, British Columbia, feeding on CEANOTHUS.

TWO NEW SPECIES OF SPHEX.

BY H. T. FERNALD, PH. D., AMHERST, MASS.

SPHEX NUDUS, sp. nov.

Head. Black, covered with long yellowish white hairs. Clypeus and frons covered with pale straw-colored pubescence to, or slightly above the insertion of the antennae, except at middle of anterior edge of clypeus where it hardly reaches the edge. A noticeable furrow passes forward (downward) a short distance, from the median ocellus. Surface of frons with rather coarse, scattered punctures. Mandibles black at base and from the bases of the two teeth to their tips; elsewhere ferruginous. Antennae black, third segment longest; scape with short, pale straw-colored hairs.

Thorax. Collar with faint scattered punctures and a few pale hairs; with a trace of yellowish white pubescence on its dorsal edge. Prothoracic lobe black, posterior portion somewhat pubescent, fringed behind with pale hairs. Just behind the lobe is a vertical band of pale yellowish pubescence more or less pronounced. Mesonotum somewhat punctured, with short grayish white hairs, and a faint median longitudinal groove on its anterior third. Scutellum rather more sparsely and finely punctured, with a slight median depression, and covered with short, grayish white hairs. Postscutellum pale yellowish white pubescent as far laterally as where the groove of the median segment leading to the stigma originates. This pubescence is frequently in part or entirely absent. Median segment finely, transversely aciculate, covered with yellowish white hairs longer than those of the mesonotum and scutellum. Above the petiole are two yellowish white pubescent areas partly confluent on the median line. Petiole short, straight, black, with yellowish white hairs.

Abdomen. Above, smooth, gray sericeous, very faintly punctured, the last two segments bearing grayish and brownish hairs directed backwards. Terminal segment rounded, somewhat compressed on its posterior half at the sides, forming a slight median ridge (Fig. 6). Beneath, glistening, somewhat sericeous, with a few scattered grayish hairs, which on the fifth, sixth, and seventh ventral plates become tufts, one on each side, on each of the segments named. Eighth segment somewhat emarginate on its hinder border. Ninth (terminal) segment rounded at the sides, with a spine on the posterior edge (Fig. 4) giving this plate the same form as that found in *Sphex flavipes*.

Wings. Nearly hyaline, the front pair very slightly fuscous. Tegulae black, margins dull ferruginous; traces of a yellowish pubescence present.

Legs. Tibiae and tarsi yellow ferruginous except last tarsal segment and claws which are much darker or almost black. Spines of legs yellow ferruginous. Coxae, trochanters, and the greater portion of femora black, the tips of the latter yellow ferruginous. Coxae sparsely punctured, sericeous, with a few scattered hairs.

Length, 18–22 mm.

Described from six male specimens: one taken in Tenn., now in the collection of the U. S. national museum; the others captured Aug. 23, 1902, at Indian Head, Md., by Mr. J. C. Bridwell on flowers of *Monarda punctata* L., and now in the collections of the American entomological society at Philadelphia, Massachusetts

agricultural college, and in Mr. Bridwell's collection. Besides these I have examined eight other specimens from Mr. Bridwell's collection and have labeled them paratypes.

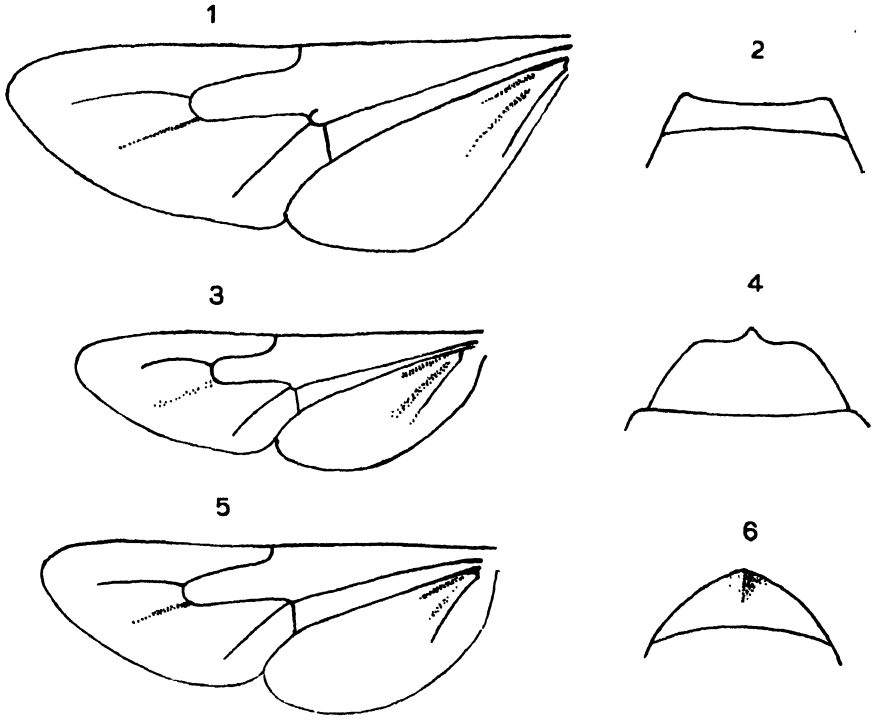


Fig. 1. Hind wing of *Sphex flavipes* Sm. Fig. 2. Last dorsal abdominal plate of male *S. flavipes*. Fig. 3. Hind wing of *S. bridwelli*. Fig. 4. Last ventral abdominal plate of male *S. nudus*. Fig. 5. Hind wing of *S. nudus*. Fig. 6. Last dorsal abominal plate of male *S. nudus*.

This species much resembles *Sphex flavipes* Sm. but the outline of the last dorsal abdominal plate (see Figures 2 & 6) provides a ready means of separation. Though well clothed with hair the general effect to the eye is that of absence of such clothing. I am of the opinion that the next species may prove to be the other sex of this, being represented by females only, and a number having been taken at the same time and place. Until this relation can be proved however, they must remain separate.

SPHEX BRIDWELLI, sp. nov.

Head. Black, with scattered dark and yellowish white hairs. Clypeus coarsely punctured, with scattered long black hairs; emarginate anteriorly, with a broad, shallow notch

at the center bounded by a slight blunt projection on each side. At the sides of the clypeus are traces of a golden pubescence sometimes extending to the bases of the antennae. Frons slightly punctured, less coarsely so than the clypeus, with scattered dark and yellowish white hairs. Eyes about equidistant at vertex and clypeus. Mandibles long, two toothed, base and teeth black, elsewhere dull ferruginous. Antennae black, third segment longest. Cheeks narrow behind the eyes, with long pale hairs, particularly below.

Thorax. Collar black, minutely punctured, with long dark and yellowish white hairs. Scutellum more sparsely and faintly punctured, with a slight median depression; its hairs very short and not noticeable. Postscutellum very faintly punctured, rather more hairy than the scutellum. Median segment finely, transversely aciculate, quite closely covered at the sides and behind with long yellowish white hairs but with no trace of pubescence except a small pale yellow spot on each side just above the petiole, not always present. Petiole black, short, straight.

Abdomen. Above, somewhat sericeous, particularly on the anterior segments, smooth except the last two segments which are coarsely punctured, the punctures being more abundant on the last. These two segments also bear short brownish hairs. Beneath, glistening, with extremely minute punctures and here and there a larger one anteriorly. These become more abundant posteriorly and are quite numerous on the last two segments. This distribution of the punctures coincides with that of the short brown hairs also present.

Wings. Uniformly fuscous with blue or violet reflection. Tegulae dull ferruginous, more or less mingled with black.

Legs. Coxae, trochanters, and greater portion of femora black. Outer ends of femora, the tibiae, and the tarsi except the last segment, pale ferruginous. Last tarsal segment and claws much darker or nearly black. Spines yellow ferruginous.

Length, 22–25 mm.

Described from six female specimens: one from the U. S. national museum, without locality; one from the American entomological society, collected in Ga.; three collected at Indian Head, Md., Aug. 23, 1902, on *Monarda punctata* L., by Mr. J. C. Bridwell for whom I take pleasure in naming the species; and one from Md. now in the collection of the Massachusetts agricultural college. I have also seen ten other specimens from the same localities, with one exception which was collected June 20, 1883 at New Orleans, La.

The two species above described in many ways resemble *Sphex flavipes* Sm. and have in some cases been mistaken for it. Of *S. nudus* only males are known and these may be distinguished from males of *S. flavipes* by the differences of form of the last dorsal abdominal segment (Figures 2 and 6) and by the wings of the former being hyaline, while in the latter they are usually fuscous. *Sphex bridwelli* of which only females are known, may be distinguished from females of *S. flavipes* by the almost total absence of pubescence, giving the body a pronounced black appearance, and by the presence in the hind wing of *S. flavipes* of a short vein which leaves the cubital vein and enters the median cell just beyond the point where the discoidal vein leaves the cubital vein. No such hook-like vein is present

in the specimens of *S. bridwelli* but is seen in all the specimens of *S. flavipes* (nine) accessible to me. Whether this hook-like vein is a universal character of *S. flavipes* I cannot say, but I do not find it mentioned in any of the descriptions of this insect. (See Figs. 1 and 3.)

It is probable that the name *Sphex flavipes* Sm. will need to be replaced by another, as this name was used by Fabricius much earlier for a different insect, which brings the present *S. flavipes* under the last portion of Canon XXXIII of the A. O. U. Code.

SOME NOTES ON THE HABITS OF CERAPACHYS AUGUSTAE.

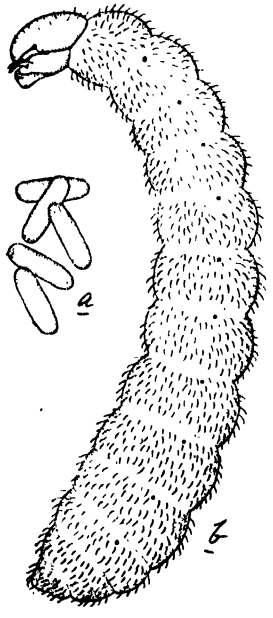
BY WILLIAM MORTON WHEELER, NEW YORK, N. Y.

A year ago I described in the Biological bulletin (Vol. 3, No. 5, Oct. 1902, p. 181–191) a singular Texan ant (*Cerapachys* [*Parasyscia*] *augustae*, of all known New World Formicidae the most primitive and generalized. The few specimens that furnished the types of the species were found under circumstances precluding a study of their habits. These, however, must be more thoroughly known before the precise taxonomic affinities of the tribe Cerapachyi to the Dorylinae and Ponerinae can be determined. I was well pleased. therefore, during the past spring to happen on another larger living colony of these extremely rare ants together with their eggs, and to be able to study their behavior for several days in an artificial nest. Unfortunately, these ants, like their allies, the Ponerinae and Dorylinae in general, do not thrive so well in confinement as the more highly specialized and plastic Myrmicinae and Camponotinae. Hence my observations proved to be rather fragmentary, but I have seen fit, nevertheless, to record them because they shed some light on the habits and development of the Cerapachyi and thus bring us a step nearer to a determination of their natural affinities.

The colony of *C. augustae*, on which the following observations were made, was discovered May 6th, 1903, near high water mark in the bottom of Shoal Creek at Austin, Texas. It was inhabiting a simple, straight gallery about 5 cm. long by 7 mm. in diameter, under the very center of a large block of limestone. At one end the gallery dipped down into the soil to a depth of 4 cm. The ants, 29 in number, were all congregated in the surface gallery with their long bodies wrapped about a large packet of eggs. Only workers were found, though careful search was made for the peculiar wingless female described in my former paper. The whole colony, with the possible exception of a few ants that may have been out foraging, was captured and placed in a small Petri dish, the bottom of which had been provided with a thin layer of damp soil partly covered with a glass microscope slide. The ants soon took up their abode under the slide after collecting their scattered eggs. Nymphs of two common Texan termites (*Amitermes tubiformans* and *Eutermes cinereus*) were cut into a few pieces and given them as food. Even when these were placed only a few millimeters from the ants, the latter showed no signs of noticing them till they were actually touched with the antennae. And even then the ants often hesitated before attacking the still struggling heads and thoraces. Eventually the termites were dispatched by the ants curling about them and using both mandibles and sting. The latter produced sudden paralysis. Then the ants eagerly lapped up the juices exuding from the cut ends of the termite fragments,

while remaining very quiet as if absorbed in the delight of feeding. The mandibles seemed to be too feeble to cut or puncture even so thin a chitinous investment as that of the termites.

The antennae are undoubtedly the most important and remarkable organs of *Cerapachys*. This is shown by their great thickness (whence the name of the genus), the differentiation of the glandiform terminal joint of the flagellum, and their singular freedom of movement. This freedom is permitted by the clypeus which is much compressed laterally in the form of a vertical crest, and does not overlap the scapes on the sides. The antennae are, in fact, kept in continual vibration in a plane perpendicular to the head with their elbows uppermost and not directed sidewise as in other ants, while the glandiform joint of the flagellum plays over the surfaces with which it comes in contact. The insects must be guided almost exclusively by the contact-odor sense in these organs since they have no trace of eyes. Pronounced negative heliotaxis, evidently depending on some photodermatic sense, was apparent when the ants were exposed to the sun, though they did not respond very readily to the lower intensities of diffuse day-light. Strangely enough, this negative heliotaxis was not associated with a high degree of positive thigmotaxis, as it is in many other insects, since the animals showed no decided tendency to conceal themselves with their bodies applied to the earth or glass. Often the whole colony would lie exposed for hours on the surface of the soil, merely agglomerated in a mass about their eggs.



As the number of eggs visibly increased during the confinement of the colony, it is clear that some of these must have been laid by the workers, as there was no female in the nest. No ants could be more careful of their eggs. They enveloped them with their bodies so that the packet could not be seen except by disturbing the whole colony. When the packet was broken apart the eggs were eagerly sought and deftly brought together again. This brooding over the eggs is quite unlike anything I have seen in other ants except Eciton, the smaller species of which (*E. opacithorax*, *schmitti*, *sumichrasti*, etc.) have a very similar habit. Besides affording protection to the eggs, it may, perhaps, serve to hasten the embryonic development. The eggs are very slender (Figure, *a*), being fully four times as long as broad. They are not kept in several packets with the long axis of the component eggs parallel with one another, as in some

Ponerinae (Leptogenys, Pachycondyla), but without any definite orientation in a single subspherical mass. The first eggs did not hatch till May 14th, showing that the incubation period must exceed eight days. They hatched rather slowly, a few at a time.

The larvae (Figure, *b*) were extremely slender, not twice as broad behind as at the anterior end, with well-marked segmental constrictions. The head is proportionately large, with strong, acute mandibles projecting beyond the clypeal and labial regions. The maxillae are furnished with a pair of prominent sensory papillae and the labium with a well-developed duct to the spinning glands. The dorsal surface of the head as well as the whole surface of the body is covered uniformly with short, slightly curved hairs. There are no traces of tubercles of any description. Attempts to observe the method employed by the ants in feeding their larvae were unsuccessful. Once, on placing a number of eggs and young larvae of *Camponotus festinatus* in the nest, I saw the young Cerapachys larvae feeding on the former after they had been carried under the slide by the workers. It was apparent also that the ants and their older larvae soon began to feed on the unhatched eggs and younger larvae of their own species, for the number of progeny decreased rapidly from day to day. In order to reduce the size of the colony and thus save as many of the young as possible from destruction, I killed and removed twelve of the workers May 17th. I was not successful, however, in stopping the infanticides, so on the following day I removed six more workers. By this time, however, though I had provided the nest daily with fresh termite food (the ants would not eat sweets, larvae of other ants, or miscellaneous insects) the Cerapachys became so demoralized that by May 19th no eggs and only five half-grown larvae remained. These larvae were carried by the ants after the manner of Eciton and Leptogenys, *i. e.* by the neck, with the long slender body extending back between the legs of the worker. The ants were quite as careful of their larvae as of their eggs.

To my intense disappointment, it soon became manifest that I should be unable to rear the few remaining larvae to the pupal stage. I therefore killed the surviving workers and the three larvae still uneaten May 20th. Thus I was unable to settle two important questions: first, the method of feeding the larvae, whether by regurgitation or with pieces of insect food; and, second, the character of the pupa, whether naked or covered with a cocoon. The powerful development of the larval jaws would seem to indicate that the young are fed with pieces of insect food, and from the fact that the larval spinning glands seem to be well developed, one may infer that the pupa is enclosed in a cocoon. Whoever is so fortunate as to happen on a colony of these ants during the middle or latter part of June will probably be able to determine the pupal characters without difficulty, as the pupae should at that time be found in the nests.

What light do these few observations, together with those recorded in my previous paper, shed on the affinities of the Cerapachyi to the Ponerinae on the one hand and the Dorylinae on the other? It is clear that the following traits of *C. augustae* are decidedly Ponerine:—

1. This ant lives in small colonies like the Ponerinae (Stigmatomma, Ponera, etc.) and not in populous colonies like the Dorylinae.

2. Its nest has a very simple structure like that of the Ponerinae.

3. The colonies are stationary like the Ponerinae and not nomadic like the Dorylinae. In confinement, at least, *C. augustae* made no attempts to leave the nest and showed none of the singular restlessness which characterizes confined colonies of Eciton, but behaved like the home-loving species of Ponera, Leptogenys, Pachycondyla, etc.[1]

4. *C. augustae* exhibits the same slow, monotonous, and timid behavior as the Ponerinae (Stigmatomma *e. g.*) in marked contrast to the intrepid, predatory instincts of the Dorylinae.

5. The female of the Texan Cerapachys is not dichthadiiform, *i. e.* shaped like the huge wingless females of Dorylus and Eciton, but resembles the workers in form and stature. Some species of Cerapachys are known to have winged females.

6. The workers are all very nearly of the same size and structure and in these respects resemble the workers of the Ponerinae. There is no tendency to polymorphism as in Dorylus and Eciton.

7. The petiole and post-petiole resemble the corresponding parts of certain Ponerinae (Stigmatomma, etc.).

[1] A fine colony of *Eciton schmitti* which I kept a few years ago, exhibited this restlessness in a striking and ludicrous manner. The colony was at first confined in a tall glass jar on a square board surrounded by a water moat. The ants kept going up and down the inside of the jar in files for many hours. Finally I removed the lid. The file at once advanced over the rim and descended on the outer surface till it reached the circular base of the jar where it turned to the left at a right angle and proceeded completely around the base till it met the column at the turning point. To my surprise it kept right on over the same circumference which was long enough to accommodate the whole colony. The ants continued going round and round the circular base of the jar, following one another like so many sheep, without the slightest inkling that they were perpetually traversing the same path. They behaved exactly as they do on one of their predatory expeditions. They kept up this gyration for 46 hours before the column broke and spread over the board to the water's edge and clustered in the manner so characteristic of this and the allied species (*E. opacithorax, sumichrasti*, etc.). I have never seen a more astonishing exhibition of the limitations (*germanice* "Bornirtheit") of instinct. For nearly two whole days these blind creatures, so dependent on the contact-odor sense of their antennae, kept palpitating their uniformly smooth, odoriferous trail and the advancing bodies of the ants immediately preceding them, without perceiving that they were making no progress but only wasting their energy, till the spell was finally broken by some more venturesome members of the colony. Recently I have found a remarkable observation of the same kind recorded by Fabre in the 6th volume of his incomparable "Souvenirs Entomologiques." He describes an army of caterpillars of the "processionnaire du pin" (Cnethocampa pityocampa) going round and round the outside of a large vase 1.35 m. in circumference for seven days! During this period the caterpillars were on the march 84 hours altogether, stopping to rest on their path only when overtaken by the cold, and not actually deviating till the eighth day. Fabre estimated that the caterpillars crawled around the vase 335 times! In this case the insects were not guided by contact-odor like the Ecitons, but by the silken thread spun by each individual over the surface traversed.

8. The eggs are shaped like those of certain Ponerinae (Leptogenys, Pachycondyla).

9. The larva probably spins a cocoon.

On the other hand *C. augustae* exhibits unmistakable Doryline characters:—

1. In the conformation of the head and antennae which closely resemble those of Eciton.

2. In the habit of brooding over the eggs.

The following characters are common to both Dorylinae and Ponerinae:—

1. The method of carrying the larvae is common to forms like Eciton and Leptogenys.

2. The larva is intermediate between that of Eciton and Stigmatomma. It is covered with shorter, less flexuous, and less abundant hairs than the latter and in these particulars resembles the larvae of Eciton.[1]

These facts go to show that *C. augustae* is a generalized form much like the hypothetical ancestor from which both Dorylinae and Ponerinae are supposed to have sprung. At the same time, the majority of the characters are Ponerine and justify us in adopting the views of Forel who places the tribe Cerapachyi with the Ponerinae. Other species of Cerapachys bear out this interpretation. Dr. Hans Brauns writes me from Willowmore, Cape Colony: "Cerapachys ist doch wohl sicher eine Poneride. *C. peringueyi* ist bei Port Elizabeth keineswegs selten, hier einzeln. Ihr ganzes Betragen ist das einer Poneride."

Owing to the close relationship of Cerapachys with both Ponerinae and Dorylinae, the recent discovery by Emery of a form (Aneuretus) intermediate between the Ponerinae and the Dolichoderinae, and the patent relationship between the Ponerinae on the one hand and the Myrmicinae and Camponotinae on the other, it is evident that the Formicidae constitute a very compact group of Hymenoptera. This unitary character of the group is still further emphasized by its comparatively recent geological origin. Hence it should be designated as a family, and its five divisions as subfamilies, in accordance with the views of European myrmecologists like Emery, Forel, Mayr, Wasmann, etc.; and the recent tendency of some Cisatlantic hymenopterists to regard the ants as a superfamily ("Formicoidea"), consisting of the five families Myrmicidae, Poneridae, etc., is not to be commended merely for the sake of making the nomenclature of this group look like that of some of the other divisions of the Hymenoptera.

AMERICAN MUSEUM OF NATURAL HISTORY,
OCT. 10th, 1903.

[1] I have not seen Emery's description of the larva of the Ponerine Ectatomma, but I have been able to examine the larvae of *E.* (*Holcoponera*) *strigatum* Norton from Guadalajara, Mexico. These larvae are nontuberculate like those of *Stigmatomma pallipes* (Biol. bull., 1900, vol. 2, p. 61, fig. 8) but covered with long, multifurcate, somewhat flexuous hairs. An exhaustive monographic study of ant-larvae would certainly repay the investigator, as they present a bewildering array of interesting characters in the various tubercles, "poils d'accrochage," etc., with which they are provided.

CLASSIFICATION OF THE GALL-WASPS AND THE PARASITIC CYNIPOIDS, OR THE SUPERFAMILY CYNIPOIDEA. IV.

BY WILLIAM H. ASHMEAD, A. M., SC. D., ASSISTANT CURATOR, U. S. NATIONAL MUSEUM.

TRIBE II. — RHODITINI.

The members of this tribe form galls only on the Roseworts (*Rosaceae*), and apparently, so far as the records go, will attack no other order of plants, the rose (*Rosa*) and the bramble (*Rubus*) especially being subject to their attacks; they show some affinity with the *Aulacini*, some of which also form galls on the *Rosaceae*, but these latter are easily distinguished by the venation of the front wings and by abdominal differences, the hypopygium not being prominent or acutely pointed as in the former, while the second segment is usually much shorter.

Walsh, deceived by the statement of a farmer, described his genus *Tribalia* as forming galls on the potato *Solanum tuberosum*, but these turn out to be root-galls on rose, closely resembling a potato. The genus is very closely allied to *Rhodites* Hartig and has been rechristened recently by Abbé Kieffer under the name of *Lytorhodites*.

TABLE OF GENERA.

1. Front wings with the marginal cell *open* along the front margin . . 2
   Front wings with the marginal cell completely *closed* 3
2. Mesonotum usually subopaque, finely punctured or coriaceous, with distinct parapsidal furrows, the middle lobe usually with a median impressed line posteriorly; scutellum rugulose, without distinct foveae at base; antennae 14-jointed in both sexes, the third joint in the ♂ not longer than the 4th and 5th united . . . . . Tribalia Walsh
   = Lytorhodites Kieffer
   (Type T. batatorum Walsh.)
3. Antennae 14-jointed in both sexes, the third joint very long, subclavate, in ♂ longer than the 4th and 5th united . . . . Rhodites Hartig
   (Type Cynips rosae Linné.)

TRIBE III.— PEDIASPIDINI.

This tribe is probably the smallest known or at least not many species have as yet been discovered, and these confine their attacks to the Mapleworts (*Sapindaceae*).

No species is yet known from America, but a more careful search for galls on our numerous species of maples will probably show that we have representatives.

The European species form galls on the leaves of *Acer pseudoplatanus* L. and fall into a single genus, which may be recognized by the following characters:—

Marginal cell *open* along the front margin, the first abscissa of the radius angulated or sub-angulated, the areolet distinct; thorax smooth, shining, with distinct, complete parapsidal furrows; scutellum somewhat elevated on the disk and higher than the mesonotum, the elevated disk is flat or has a slight median depression, either smooth or punctate; antennae in *agamous* ♀ 15- or 16-jointed, in sexual form 14-jointed in ♀ and 15-jointed in ♂, the third joint scarcely as long as the scape and pedicel united, but longer than the fourth . . . . . Pediaspis Tischbein
= Bathyaspis Förster
(Type P. sorbi Tischb.)

Tribe IV.—Aulacini.

At present this tribe is not well represented in genera and species, but probably will be found to be fully as large as the tribe *Cynipini*, since its known members attack several orders of plants and it necessarily follows that there must be many genera and species still discoverable.

The known species form galls on the Roseworts (*Rosaceae*), the Poppyworts (*Papaveraceae*), the Crucifers (*Cruciferaceae*), the Mallows (*Malvaceae*), the Sumacs (*Anacardiaceae*), the Asterworts (*Compositaceae*), the Heathworts (*Ericaceae*), and the Figworts (*Scrophulariaceae*).

Sixteen genera are already known which may be recognized by the use of the following table:—

Table of Genera.

1. Marginal cell *closed* along the front margin 2
Marginal cell *open* along the front margin.
First abscissa of the radius curved, the apical branch of the subcostal vein straight; parapsidal furrows sharply defined, complete; antennae in ♀ 13–14-jointed, the third joint shorter than the fourth or no longer, in ♂ 14-jointed. . . . . Aulacidea Ashmead
(Type Aulax mulgidiicola Ashm.)
First abscissa of the radius almost straight, the apical branch of the subcostal vein curved; parapsidal furrows incomplete or vaguely, indis-

tinctly defined posteriorly; antennae in ♀ 13-jointed, the third joint longer than the fourth, in ♂ 15-jointed. . . Phanacis Förster
(Type P. centaureae Först.)

3. Areolet in front wings entirely absent, or at most with only one side present 11

Areolet in front wings distinct, triangular.

Areolet not lying directly beneath the origin of the radius . . 5

Areolet lying directly beneath the origin of the radius or at least its base is on a line with the origin of the radius.

Scutellum at base distinctly bifoveated, the foveae separated by a carina 4

Scutellum at base without foveae, but with a transverse furrow, the bottom of the furrow being finely streaked.

Thorax coriaceous, with indistinct parapsidal furrows; areolet very delicate, nearly obsolete; antennae in ♀
Solenozopheria Ashmead
(Type S. vaccinii Ashm.)

4. Scutellum in outline conical or pyramidal; mesopleura on lower half coarsely sculptured, the disk with some striae; antennae in ♀ 13-jointed, the third joint distinctly longer than the fourth, in ♂ 14-jointed Gonaspis Ashmead
(Type Diastrophus scutellaris Gillette.)

Scutellum normal, rounded or obtuse behind, never conical or pyramidal; mesonotum smooth, not longitudinally striated, the parapsidal furrows distinct; antennae in ♀ 14-jointed, in ♂ 15-jointed. Diastrophus Hartig
(Type D. rubii Hartig.)

5. Mesonotum perfectly smooth and shining, with the parapsidal furrows distinct, or at least sharply defined posteriorly 6

Mesonotum *not* perfectly smooth and shining, shagreened, coriaceous, finely punctate, or longitudinally striated 7

6. Antennae in ♀ 13-jointed, in ♂ 15-jointed, the third joint not longer than the fourth; scutellum rugulose; metathoracic carinae absent Xestophanes Förster . . . . . (Type Cynips potentillae Retzius.)

Antennae in ♀ and ♂ 14-jointed, the third joint a little longer than the fourth; scutellum almost smooth; metathorax with two parallel, widely separated carinae . . . . . Gillettea Ashmead
(Type G. taraxaci Ashm.)

7. Mesonotum not longitudinally striated, either shagreened, coriaceous, or very closely finely punctate, with the parapsidal furrows distinct . . . 8

Mesonotum longitudinally striated, with the parapsidal furrows very short and indistinct.

Antennae in ♀ 14-jointed (♂ unknown), the second joint longer than the third, the latter longer than the fourth; claws finely denticulate
Pantelliella Kieffer
(Type P. fedtschenkoi Kieffer.)

8. Head oblong, longer than wide 10
Head normal, transverse.
Foveae at base of scutellum of moderate size, neither large, triangular, nor deep 9
Foveae at base of scutellum large, deep, and triangular, extending to the middle of the scutellum.
Antennae in ♀ 13-jointed, the third joint somewhat shorter than the fourth, in ♂ 14-jointed, filiform, the third joint shorter than the fourth . . . . . Isocolus Förster
= Eubothrus Förster
(Type Diastrophus scabiosus.)

9. Antennae in ♀ 13-jointed, the third joint distinctly shorter than the fourth, in ♂ 15-jointed, filiform, the third joint a little longer than the fourth
Pseudaulax Ashm. gen. nov.
(Type Cynips hieracii Löw.)
Antennae in ♀ 14–jointed, the third joint usually as long as the fourth, in ♂ 15-jointed, the third joint *not* longer than the fourth . Aulax Hartig
(Type Cynips rhoeados Bouché.)

10. Antennae in ♀ 13-jointed (♂ unknown); scutellum ovate, tuberculate
Cecconia Kieffer
(Type Aulax valerianellae Thomson.)

11. First abscissa of the radius straight, or very nearly, not angulated or curved; mesonotum coarsely coriaceous or shagreened, opaque; head bulging out behind the eyes, the cheeks longer than the eyes 12
First abscissa of the radius curved or subangulated; mesonotum smooth, shining, or at the most alutaceous; head not bulging out behind the eyes, the cheeks shorter than the eyes.
Antennae in ♀ 13 or 14-jointed, the third joint not shorter than the fourth, usually a little longer, in ♂ 14-jointed . . Liposthenus Förster
(Type Aulax glechomae Hartig.)

12. Middle mesothoracic lobe *with* a distinct median grooved line its entire length or only vaguely defined anteriorly; foveae at base of scutellum not very distinct; third joint of antennae much longer than the fourth . . 13
Middle mesothoracic lobe *without* such a grooved line, at the most with only a short grooved median line posteriorly; foveae at base of scutellum distinct; third joint of antennae shorter than the fourth.

Antennae in ♀ 14-jointed, the third joint shorter than the fourth, in ♂ 15-jointed; second abdominal segment not occupying much more than half the length of the whole surface of abdomen Antistrophus Walsh
(Type A. pisum Walsh.)

Antennae in ♀ 13-jointed, the third joint much shorter than the fourth, in ♂ 14-jointed, the fourth joint much longer than the third; second abdominal segment occupying fully two thirds the whole surface of the abdomen dorsally, but ventrally it is much shorter Asclepiadiphila Ashmead . . . . . (Type A. stephanotidis Ashm.)

13. Antennae in ♀ 14-jointed, the third joint very long, nearly twice as long as the second; second abdominal segment large, occupying about four fifths the whole surface of the abdomen . . . . Timaspis Mayr
(Type T. phaenixopodos Mayr.)

Tribe V.— Eschatocerini.

The members of this tribe attack plants belonging to the order *Leguminoseae*. Not many species are known and these fall into a single genus, *Eschatocerus* Mayr, described from South America. I have, however, an undescribed species from California and I suspect when our sensitive plants, milk-vetches and our many other leguminous plants are carefully examined for galls, many other genera and species will be discovered.

The tribe is easily separated from the others by the antennae being inserted high up on the face *above* an imaginary line drawn from the apex of the eyes, and by peculiarities of venation. The single genus may be characterized as follows:—

Front wings with a callosity at the union of the basal nervure with the median vein and another along the first abscissa of the radius, the areolet being obliterated and the cubitus originating from this callosity; hypopygium plow-share shaped, without a prominent spine; antennae in ♀ 13-jointed, the third joint about equal to the fourth, in ♂ 14-jointed, the third joint a little longer than the fourth . . . . . Eschatocerus Mayr
(Type E. acaciae Mayr.)

Subfamily III.— Ibaliinae.

This group is quite distinct from all others in the venation of the front wings, in having the abdomen long and very strongly compressed, cultriform or knife shaped, and in the totally different shape of the legs, the hind tibiae being very long, longitudinally furrowed, with two apical spurs, while the basal joint of the

hind tarsi is somewhat thickened and abnormally lengthened, being nearly twice as long as joints 2–5 united. It shows some affinity with the *Figitidae*, and particularly with the subfamily *Liopterinae*, and may yet be classified with that family, its members being genuine parasites. but with quite different hosts from those of the Figitides. In Europe, Mr. André has bred *Ibalia leucospoides* Hochenwarth from a Horn-tail, *Sirex gigas* L., while in America, Mr. W. Hague Harrington has ascertained that *Ibalia maculipennis* destroys the larvae of *Tremex columba* L. and *Xiphydria albicornis* Harris. In the Riley Collection is a single specimen of *Ibalia maculipennis* labeled, "So. Ill. bred from Hickorywood, June 4th, 1875," so that probably the group attacks any member of the superfamily Siricoidea, and is therefore of great economic importance.

The single genus known may be recognized by the following characters:—

Thorax coarsely, transversely rugulose; front wings with the marginal cell long, narrow lanceolate and usually closed; antennae in ♀ 13-jointed, filiform, in ♂ 14-jointed, the third joint excised beyond the middle . Ibalia Latreille
(Type Ichneumon leucospoides Hochenw.)

Addenda. Abbé J. J. Kieffer has characterized two genera not included in my genera of the *Onychiinae*, Psyche, vol. 10, p. 11. In order that these genera may not be overlooked I give below a revised table of the genera:—

Table of Genera.

1. Scutellum *not* spined 2
   Scutellum spined 5
2. Marginal cell *closed*, more or less, at the base; hind tibiae *without* longitudinal ridges 3
   Marginal cell *open* at the base and along the front margin; hind tibiae with longitudinal ridges 4
3. Mesonotum smooth, polished, with two distinct furrows, without carinae; scutellum *without* a median longitudinal carina; marginal cell *closed* along the front margin; petiole of abdomen smooth. . Homalaspis Giraud
   Mesonotum scabrous, with three longitudinal carinae; scutellum *with* a median longitudinal carina; marginal cell *open* along the front margin; petiole of abdomen furrowed . . . . . Lambertonia Kieffer
   (Type L. abnormis Kieffer.)
4. Scutellum *without* a channel throughout and without transverse ridges
   Tavaresia Kieffer
   (Type T. carinata Kieffer.)

Scutellum *with* a deep channel throughout and with transverse ridges
Onychia Haliday

5. See my table from 2 for the other genera.

Abbé Kieffer in Wytsman's Genera Insectorum, Fam. Cynipidae, p. 9, has incorrectly included *Solenaspis* Ashm. with the *Onychiinae;* it is a *genuine* Figitine and *not* an Onychiine.

SOME APHIDS ASSOCIATED WITH ANTS.

BY WILMATTE PORTER COCKERELL, COLORADO SPRINGS, COL.

The species of Lasius which occur here attend both aphids and mealy bugs in large numbers and great variety. During the past two years my husband and I have made somewhat extended observations on the behavior of the ants toward their captives and upon the distribution both of the ants and their prisoners. We are indebted to Dr. Wm. M. Wheeler for the identification of the ants.

The species of ants studied make their nests under flat stones. In this climate the ants are active during the most of the winter, and live in the corridors under the stones, except in very severe weather, when they retire into their subterranean chambers carrying their aphids and coccids with them. In the long droughts to which this region is subject the ants are obliged in most places, to live far underground, and after such a siege the number of aphids and coccids is small. In the summer, which is the rainy season, the ants' nests are often greatly extended and large chambers are made about the roots of plants.

FORDA KINGII, sp. nov.

♀ Body oval or ovate, gray drab to greenish with sutures inconspicuous. Head not distinct from the rest of the body; eyes small but distinct. The whole body including antennae is sparsely hairy. The cauda is a distinct rounded tail decidedly hairy on the end. Legs as in *Tychea lasii*.

Antennae five jointed, short, and slender; first and second joints subequal, third about three times as long as second, fourth about as long as second, fifth with a short cylindrical spur about one half the diameter of the segment and including spur only slightly longer than the fourth. Sensoria distinct. Length of antennal joints (1) 60 (2) 60 (3) 135 (4) 60 (5) 78 + 12 μ.

HAB. — Found in nests of *Lasius claviger*, *L. flavus*, *Formica* sp., *L. americanus*, at Lawrence, Mass., Andover, Mass., Methuen, Mass. Collected by Mr. George B. King who writes: "feed on roots of grass in ants' nests under stones; young are brownish."

FORDA INTERJECTI, sp. nov.

♀ Body oval or ovate, bright yellow, with sutures more distinct than in *F. kingii*. Head broad with tubercle below the eye. Eyes small and dark. No hairs on body and antennae as in *F. kingii;* antennae more slender. Cauda brown and hairy. Length of antennal joints (1) 45 (2) 60 (3) 120 (4) 60 (5) 114 + 24. A few hairs are found on the end of joint five.

HAB. — Found at Las Vegas, N. M., Mar. 24, Oct. 11, and at Las Valles, N. M., Mar. 22. (W. P. & T. D. A. Cockerell.)

TYCHEA LASII, sp. nov.

♀ Body oval or ovate, a smooth shining greenish yellow with sutures inconspicuous. Head broad and subtruncate; its front width about half its length and about one fifth its width at point of attachment to body. Eyes moderately large placed near the posterior angle of the head; eyes dark brown or black not on tubercles. No hairs on body, legs, or antennae. Length of body 2 mm.

Prothorax set off from the remaining portion of the body by a slight constriction or deepening of the suture. Remaining body segments without distinct markings or structures above; they grow gradually shorter to the posterior extremity. The cauda is light brown and is not hairy. The spiracles are brownish and very distinct.

The under surface is colored as the upper. The upper portion of the beak is light brownish yellow, extreme tip dark brown.

Legs brown, moderately long; the anterior coxae closely embracing the base of the head, the others widely separated from each other by the broad flattened meso- and meta-sternum. Two distinct claws and two tarsal joints on all the legs.

Antennae five jointed; second and third joints nearly subequal, fourth very short, fifth with short cylindrical spur about one half the diameter of the segment. The spur has a few hairs (three or four — very short) at the end. Sensoria on fourth and fifth joints large and conspicuous. Length of antennal joints (1) 60 (2) 90 (3) 99 (4) 36 (5) 115 + 30.

HAB.— Found, Jan. 12, on banks of Gallinas River near Las Vegas, N. M., with *Lasius americanus*. Collected several times since.

TYCHEA PALLIDULA, sp. nov.

Differs from *T. lasii* by its light yellow color, small size, eyes on tubercles, and relative length of antennal joints, (1) 30 (2) 60 (3) 56 (4) 30 (5) 90 + 18.

HAB. — Beulah, N. M., 8000 ft. Collected March 28 and several times since.

It was thought at first that this was the immature form of *T. lasii* but the specimens examined contained eggs and smaller specimens of *T. lasii* show the third antennal joint as long as or longer than the second and the eyes never on tubercles.

TYCHEA CRASSA, sp. nov.

Differs from *T. lasii* in being larger, globose, of a brownish color, and having hairy legs and antennae and sparsely hairy body. Eyes very prominent on tubercles.

Length of body 3 mm. Length of attennal joints (1) 75 (2) 117 (3) 132 (4) 69 (5) 114 + 30.

HAB. — Found, April 2, at Old Pecos, near Rowe, N. M.

I give below tables for the separation of the species of Forda and Tychea found in America.

FORDA.

A. Joint 3 not nearly twice as long as 1 + 2.
   a. Spur on end of 5th joint relatively long . . . *interjecti*, sp. n.
   b. Spur on end of 5th very short . . . . *kingii*, sp. n.
B. Joint 3 nearly twice as long as 1 + 2 . . . . *occidentalis* Hart.

TYCHEA.

A. Hairy; size large . *crassa*, n. sp. and *phaseoli* — probably *phaseoli*. Garman, 7th Kentucky Rept., but apparently not the European *phaseoli*.
B. Smooth.
   a. 2d and 3d subequal.
      1. Joint 5 with spur not so long as 3 + 4 . *groenlandica* Rübs.
      2. Joint 5 with spur longer than 3 + 4
         1′ eyes on tubercles . . . . . *lasii*, sp. n.
         2′ eyes not on tubercles . . . . *pallidula*, sp. n.
   b. 3d nearly as long as 1 + 2 . . . . . *brevicornis* Hart.

APPEARANCE OF THE 17-YEAR CICADA IN RHODE ISLAND IN 1903.

BY ALPHEUS S. PACKARD, PROVIDENCE, R. I.

The interesting fact of the occurrence of a brood of *Cicada septemdecim* within the limits of Rhode Island was, early in June of the present year, contributed to the Providence Journal by Mr. James M. Southwick, the curator of the Museum of natural history of Roger Williams Park, Providence. Specimens and information

regarding their appearance were afforded him by Mr. Charles E. Ford, of Providence, who afterwards called on me, and kindly gave the following account. In driving, June 2, in the town of Coventry, at a point about two miles southwest of Washington village, near the southwest end of Tiogue Reservoir, not far from the New London Turnpike, he was attracted by a loud shrill noise like the concert of the "purring toad." He saw the scrub oak and other bushes for a distance of about one eighth of a mile "covered with them"; a great many nymph skins were observed clinging to the bushes, and the ground was full of the holes from which the nymphs had crawled out. Mr. Ford also told me that his grandfather observed the same insects at the same locality thirty-four years previously, and that he carried two or three of them to his house and showed them to his family, his mother remembering the circumstance.

Hoping to verify this information, I went to Washington, but owing to continuous stormy weather lasting over two weeks, I was unable to reach the locality until June 27. It was easily found, the holes and nymph-skins occurring over an area extending about an eighth of a mile on the south side of the road from Washington near "The Pat," now a rope manufactory, to the New London turnpike, on rather high land, formerly covered with oaks, chestnuts, and a few pines, but now overgrown with scrub oaks and chestnuts.

The nymph skins were abundant, and the scattered holes were numerous, sometimes as many as from 4 to 8 to a square foot. It was too late to find any living Cicadas, as they may have died somewhat prematurely from the effects of the prolonged cold stormy weather.

The dismembered bodies of the dead Cicadae, wings, separate abdomens, and legs, were picked up. As they were seen alive June 18-19, the fact that those I saw had been broken up and partly destroyed, perhaps by the little black ants frequenting the spot, shows how rapidly insect-remains disappear after death, and accounts for the fact that so few entire dead insects are to be found on the surface of the soil. They had laid but a few eggs; only one or two oak twigs contained a full complement of eggs, whose presence was indicated by the withered leaves, the twig having been perforated, broken, and bent down.

Mr. L. F. Bennett, living near by, told me that he saw them alive in the trees on June 6 of the present year, and that seventeen years ago a lady saw them in this same locality, *i. e.*, near "The Pat," then called Barclay's.

Mr. A. J. Andrews, the proprietor of the rope manufactory at "The Pat," was familiar with the Cicada, telling me that his father heard and saw them "about 17 years ago" at Spring Lake, or "Maple root," a locality in eastern Coventry two miles northwest of "The Pat," near Mishnock River, a small stream flowing into the Pawtuxet a little west of the village of Washington. He said he heard them

singing, and put several of them in a tin box, carrying them home. A third locality, reported to me by Mr. Andrews, is in East Greenwich, near the West Greenwich line at "Shippies," about half a mile east of Carr Pond. They were seen here June 18–19, 1903.

I may add that Mrs. Emma Wiggins of Anthony, R. I., kindly wrote me that Mr. Carpenter of Washington, R. I., saw the 17-year Cicada in the "Pat" region about the middle of June this year. He told her that it also appeared there seventeen years ago; that he has one in his house that was collected in the same place thirty-four years ago.

The specimens I collected agreed in size, markings, and color with others from the middle states in my collection, presenting no local variations.

It thus appears that there have been three visitations of the 17-year Cicada in Rhode Island, *i. e.* in 1869, 1886, and certainly in 1903, and that it appears in isolated places, not continuously over an extensive area.

It may be of interest to recall that Harris, in his Treatise on the injurious insects of Massachusetts, states that this insect is known to have appeared at Plymouth, Mass., in 1633, at Plymouth, Sandwich, and Falmouth, Mass., in 1804, at Sandwich in 1787, 1804, and 1821. Also in the Connecticut Valley at Hadley 1818, Westfield, 1835, North Haven, Conn., 1724, 1741, 1758, 1792, *1809*, *1826*, 1843, and at Martha's Vineyard in 1833. From these dates it would seem that there is a discrepancy between the Rhode Island years and those of Eastern Massachusetts and Martha's Vineyard, the estimated Rhode Island year, being for the past century *1808*, *1825*, *1842*, 1869, 1886, and 1903.

Desirous of ascertaining whether this Cicada had appeared in Massachusetts this year, I wrote to Prof. H. T. Fernald, Associate entomologist of the Hatch experiment station, Amherst, Mass., who writes me as follows: —

"I made a quite thorough investigation of this insect this year as we expected it here. I obtained the aid of the Secretary of our State Board of Agriculture and through him inquired as to its presence, of all of his correspondents in the state, besides many of my own. In this way I reached every county and quite a number of towns in each county, there being over 200 persons in all. Not one of them either saw or heard of the Cicada this year, and I am satisfied that it was not present in the Connecticut valley part of Massachusetts at least, from my observations, and as no one reported it from anywhere else I think that if it was present it must have been very local."

NOTES ON ACANTHOTHRIPS.

BY H. J. FRANKLIN, B. S., AMHERST, MASS.

On the 9th of September, 1903, five females and one male *Acanthothrips magnafemoralis* Hinds, were found under the loose bark of a sycamore tree near the college grounds. Since then, a large number of specimens have been found on the same tree. While I have not found them on other sycamores in the neighborhood, their numbers on this tree would seem to indicate that the sycamore is their food plant. It is possible, however, that they fed, during the summer, on plants near this tree and that they were simply preparing to hibernate under its bark.

Acanthothrips magnafemoralis was originally reported from Miami, Florida. Dr. Hinds gave a very good description of the male of this species from a single specimen and, since that time, no further account of the insect seems to have appeared and no description of the female has been published.

Female.— The female, although generally larger, more robust, and with a more swollen abdomen, closely resembles the male in most respects.

Length 2.28 mm. (2.1 to 2.7 mm.); width of mesothorax 0.49 mm. (0.47 to 0.52 mm.). Relative lengths of the segments of the antennae as follows:

Number of segment,	1	2	3	4	5	6	7	8
Spaces of micrometer,	12.3	18.4	37	34	29.6	18.4	18.2	10.5

Described from nine specimens.

Two cotypes (two slides) have been deposited in the United States national museum. Three cotypes (two slides) have been deposited at the Massachusetts agricultural college. I have retained four cotypes (one slide).

The color of the male and female both is more or less tinged with red, as seen by transmitted light, owing to the presence of scattered hypodermal pigmentation. Fore femora strongly compressed; two apical segments of the antennae of both sexes with a straight, longitudinal row of about ten setae seen on the outer side of the segments above, when the antennae are anteriorly directed, beginning at the apex of the last segment; surface of the abdominal segments reticulated.

The description of this insect by reflected light is, in many respects, quite different from that by transmitted light.

By reflected light, the general color of the body above is seen to be light grayish tinged with red; the eyes and ocelli are brick-red in color; the last two segments of the abdomen before the tube are pale yellow and the outer two thirds of the tube is black. There is a dark brown, longitudinal, median basal stripe on the head above and the fore femora usually bear one or two isolated brown dots. A broad,

Y-shaped, dark brown stripe begins on the mesothorax, crosses the metathorax, and extends on the dorsum of the abdomen to the posterior margin of the seventh segment. The base of the stripe is median on the dorsum of the abdomen and grows gradually wider anteriorly; it is narrowed between the segments. The arms of the Y nearly reach the anterior angles of the mesothorax. On the thorax, the stripe is somewhat lighter in color having a distinct reddish tinge. The posterior angles of all the abdominal segments above, except the last three, are distinctly flecked with pure white. There is also a somewhat indefinite white spot on each side of the dorsal stripe on each side segment. The appearance of the ventral side of the insect is the same by reflected as by transmitted light.

Larva. — On the 23d of October, 1903, several specimens, apparently all belonging to the same larval instar, were found congregated together with a number of adults.

Length 1.2 mm.; width of meso-thorax .36 mm. General shape fusiform; color red.

Head quadrate and lighter in color than body; cheeks straight and parallel; post-ocular bristles prominent and knobbed. The head also bears four other bristles which are similar to those behind the eyes; two of these are situated between the eyes, one on each side, about half-way between the middle of the head and the margin of the eye; the other two are situated about half-way between these and the margin of the thorax. The eyes are small, round, black in color, and very widely separated. Antennae consisting of seven segments, light-brown in color, the third segment the longest; second segment bearing knobbed hairs, fourth and fifth segments bearing sense cones; apical segment bluntly pointed and bearing a long, slender, acute hair at its end.

Thorax red, with irregular and indefinite transparent markings; bearing knobbed hairs like those on the head on all three segments. Legs very light brown in color; femora bearing knobbed hairs; tarsi bearing two strong claws.

Abdomen about one-half the length of the body, tapering gradually to the end of the tube; red in color, with irregular transparent markings; first segment transparent, fourth segment somewhat lighter than the others. All the segments, except the last two, bear knobbed hairs. Toward the posterior part of the abdomen, the hairs gradually grow longer. Around the posterior margin of the 9th segment there is a circlet of long spines which are strongly bent near their tips. The tube is about two thirds the length of the head, tapers gradually from base to apex, is light brown in color, and bears a circlet of acutely pointed spines at its tip; only two of the eight extremely long hairs seen in the adult are developed and these are on the ventral side of the tube in all my specimens.

On October 3rd, 1903, I found a large female *Acanthothrips nodicornis* Reut. also under the bark of the sycamore. This is the species on which Uzel founded the genus and it does not seem to have been reported heretofore in this country.

It would be useless for one to attempt to redescribe the species from one specimen, but this species may be readily distinguished from *magnafemoralis* by its larger size and dark brown color. The last three abdominal segments are dark

brown and the tube does not bear a circlet of eight very long hairs as in *magnafemoralis*. There is a very distinct white fleck, seen by reflected light, on the anterior corners of all the abdominal segments above, except the two basal and the two apical. Uzel gives the average length of the females of the species as being 2.4 mm. My specimen is a very large one measuring about 3 mm. in length.

The foregoing studies were made at the Entomological laboratory of the Massachusetts agricultural college.

THE HEMIPTERA DESCRIBED BY PHILIP REESE UHLER. IV.

BY SAMUEL HENSHAW, CAMBRIDGE, MASS.

JASSIDAE.

AGALLIA

albidula, 45–84 St. Vincent.
capitata, 45–83 St. Vincent.
fascigera, 45–82 St. Vincent.
nigricans, 45–82 St. Vincent.
siccifolia, 16–359 (Bythoscopus) Col.: Eagle river, Denver; Tex.; B. Col.; Can.; N. E. = sanguinolenta Prov. (1874).
ustulata, 45–85 St. Vincent.

CICADULA

exitiosa, 20–72 Md.: shores of Chesapeake bay, Woodbury, Curtis Creek, Kent Co.; Col.: Denver; Tex.; Fla.; N. C.; S. C.

COCHLORHINUS, 16–358

pluto, 16–358 Cal.

DELTOCEPHALUS.

acuminatus, 45–80 St. Vincent; S. United States.
argenteolus, 17–473 [Col.]: Colorado Springs, near Manitou.
colonus, 45–80 St. Vincent; S. United States.
configuratus, 19–511 N. Mont.: Mills river region.
cuneatus, 45–79 St. Vincent.
debilis, 16–360 Col.: near Fair Play, South Park.
retrorsus, 45–78 St. Vincent; Fla. to coastal plain, N. J.; Md.
sagittifera, 45–76 St. Vincent.
virgulata, 45–76 St. Vincent; Cuba; Fla.; E. N. C.; C. Ill.; Brazil; Para; E. Va.; N. J.; Md.

EUACANTHUS

angustatus, 47–293 Japan.

GYPONA

albosignata, 45–74 St. Vincent; coast plain U. S., N. to Cape Ann, Mass.
angustata, 45–74 St. Vincent.
cinerea, 17–460 [Col.]: near Manitou; Kans.; Ut.; Ill.; Conn.

HECALUS

fenestratus, 17–464 (Glossocratus) N. J.
lineatus, 17–463 (Glossocratus) N. J.

IDIOCERUS
ramentosus, 17–465 (Bythoscopus) [Col.]: Denver, Clear Creek Canon, Manitou.
JASSUS.
divisus, 17–472 [Col.]: Denver, near Sloan Lake.
excultus, 17–467 Fla.; Geo.; Tex.; Ill.; Mass.; Pa.; N. J.; N. Y.; Minn.; Kans.; [Col.]: near Denver, Pueblo; Md.
plutonius, 17–470 [Col.]: Clear Creek Canon; Tex.; Dak.
PACHYOPSIS, 17–466
laetus, 17–466 [Col.]: Manitou, near Canon City.
mundus, 47–292 Japan.
robustus, 17–467 N. Mex.; Tex.: Waco.
PARABOLOCRATUS
guttatus, 47–291 Japan.
viridis, 17–462 (Glossocratus) Col.: near Golden, W. of Denver; E. Mass.; Conn.; N. Y.; Can.; Ill.
PARAMESUS
jucundus, 17–469 (Jassus) [Col.]: Manitou; Md.; Tex.
twiningi, 19–511 (Jassus) [Dak.]: Turtle mt.; Pembina.
PARAPHOLIS, 17–461 = Xerophloea Genn. (1839).
PETALOCEPHALA
discolor, 47–290 Japan.
PROCONIA
confluens, 3–285 N. W. Wash.
fastigiata, 45–75 St. Vincent: Kingston.
rubricora, 45–75 St. Vincent: Kingston.
SCAPHOIDEUS, 30–33
consors, 30–36 Md.; Tex.: Waco.
intricatus, 30–34 Md.; Va.: Piedmont region, Atlantic coastal plain; N. J.
jucundus, 30–34
stigmosus, 45–77 St. Vincent: Kingston.
SELENOCEPHALUS
cincticeps, 47–292 Japan.
vittatipes, 47–292 Japan.
SPANGEBERGIELLA
vulnerata, 17–464 (Glossocratus) C. Tex.
TETTIGONIA
guttigera, 47–294 Japan.

THAMNOTETTIX

belli, 17–471 (Jassus) Col.: Manitou.
kennicotti, 6–161 (Jassus) [Md.]: near Baltimore.
laeta, 16–360 (Jassus) Col.
sellata, 47–294 Japan.

TYPHLOCYBA

aureoviridis, 17–474 [Col.]: Denver, Clear Creek Canon.

XEROPHLOEA

peltata, 17–461 (Parapholis) [Col.]: Clear Creek canon; Tex.; Mex.; Cuba; Hayti; Geo.; Mass.; Md.

CERCOPIDAE.

APHROPHORA

flavipes, 47–289 Japan.
indentata, 47–290 Japan.
intermedia, 47–288 Japan.
major, 47–287 Japan.
obliqua, 47–288 Japan.
permutata, 16–345 Col.; Ut.; Cal.: near San Francisco.

CLASTOPTERA

delicata, 16–348 Col.; Ut.
stolida, 6–161 Cuba.
undulata, 6–160 Cuba.

LEPYRONIA

angulifera, 16–348 N. W. Fla.; Md.: S. of Baltimore; N. J.: Ocean Co.; Cuba; Tex.; Northern Mexico.
grossa, 47–285 Japan.

MONECPHORA

assimilis, 47–285 Japan.
fraterna, 6–160 Cuba.

PHILAENUS

abjectus, 16–346 Col.

PHILAGRA

albinotata, 47–286 Japan.

MEMBRACIDAE.

MACHAEROTYPUS

sellatus, 47–284 Japan.

ORTHOBELUS
flavipes, 47–284 Japan.
PUBLIA
modesta, 16–344 Col.; Ut.; Dakota; Ariz.; N. Mex.; Cal.
TELAMONA
pyramidata, = –1333[1] S. Col.

FULGORIDAE.

AMBLYCRATUS
pallidus, 45–65 St. Vincent; Kingston.
APHELONEMA, 16–356
simplex, 16–356 Dakota.
BELONOCHARIS, 35–145
fumida, 35–146 Cal.: Los Angeles Co.
CATONIDIA, 47–281
intricata, 45–61 St. Vincent: Petite Bordette valley.
sobrina, 47–282 Japan.
CENCHREA
equisita, 45–69 St. Vincent: Kingston.
CHEILOCEPS
musca, 45–68 St. Vincent.
CIONODERUS
lineatus, 45–66 St. Vincent.
CIXIUS
subnubilus, 47–279 Japan.
CORTYLECEPS
decorata, 45–64 St. Vincent: Kingston.
marmorata, 47–280 Japan.
procellata, 52–511 Hayti: Port au Prince.
CUBANA
irrorata, 45–63 St. Vincent.
tortrix, 45–62 St. Vincent: Kingston.
CYPHOCERATOPS, 52–510
furcatus, 52–511 Cuba.
DANEPTERYX, 30–42
manca, 30–42 Cal.: Los Angeles.

[1] See note, p. 88.

DASCALIA
acuta, 52–514 San Domingo; Hayti; Cuba; Fla.
guttata, 52–513 Hayti: Port au Prince; Cuba.
DICTYOBIA, 30–39
permutata, 30–39 Cal.: vic. Los Angeles.
DICTYONIA, 30–40
obscura, 30–41 Cal.: San Francisco.
DICTYONISSUS, 16–355
griphus, 16–356 Tex.: near Waco.
DICTYOPHARA
emarginata, 45–58 St. Vincent.
DIOSTROMBUS, 47–283
politus, 47–284 Japan.
DYCTIDEA, 30–37
angustata, 30–37 [Cal.]: Los Angeles.
intermedia, 30–38 [Cal.]: vic. Los Angeles.
ISSUS
aciculatus, 16–353 Fla.: Orange Springs; Tex.
auroreus, 16–352 Tex.
LIBURNIA
vittatifrons, 16–351 Dak.; Ill.; Md.; N. J.
MONORACHIS, 52–509
sordulentus, 52–510 Fla.: near Lake Worth.
MYNDUS
apicalis, 47–281 Japan.
ORMENIS
contaminata, 45–71 St. Vincent.
robusta, 52–515 Hayti: Port au Prince; San Domingo: near Samana Bay.
ORTHOPAGUS, 47–278
lunulifer, 47–279 Japan.
OTIOCERUS
flexuosus, 47–283 Japan.
PROSOTROPIS
decorata, 45–70 St. Vincent.
RICANIA
albomaculata, 47–277 Japan.
SCARPOSA
tumida, 45–73 St. Vincent.

SCOLOPS
angustatus, 16–350 Neb.; Dak.; Iowa; Mass.; Conn.
desiccatus, 51–407 C. Tex.
grossus, 16–350 Tex.
hesperius, 16–349 S. Col.: Denver City.
pallidus, 51–404 Cal.: Los Angeles.
perdix, 51–405 Ariz.; Col.; N. Y.; Mass.
spurcus, 51–403 Mo.: St. Louis; Kans.: Riley Co.; Md.: coastal plain.

STIROMA
inconspicua, 17–458 [Col.]: Clear Creek Canon.

TANGIA
angustata, 45–59 St. Vincent; Grenada.

TANGIDIA
alternata, 45–60 St. Vincent.

TANGIOPSIS, 52–512
tetrastichus, 52–512 Hayti: Port au Prince.

TANGYRIA, 52–512
frontalis, 52–512 Hayti: Port au Prince.

TICIDA, 35–143
cingulata, 35–144 Cal.: Los Angeles Co.

TYLANA
ustulata, 16–354 Col.; Ariz.
ustulipunctata, 16–355 Cuba; Mex.

VINCENTIA
interrupta, 45–67 St. Vincent.

CICADIDAE.[1]

CARINETA
socia, 14–285 Lower Amazons.

CICADA
bilaqueata, *–7 Brazil: Chapada.
egregia, *–5 Brazil: near Rio de Janeiro.
obtusa, *–11 Brazil: near Chapada.
pellosoma, 2–283 China: Hong Kong.
reperta, 37–177 Fla.; N. C.: Newbern; [La.]: vic. New Orleans.
reticularis, 36–157 Jamaica: E. of Kingston.
sordidata, 36–175 S. Fla.
sublaqueata, *–9 Brazil: near Chapada.

[1] Species described in the recently published, and as yet unfinished, paper, Enumeration of the Cicadidae of Brazil in the collection of Mr. Herbert H. Smith. Trans. Maryland acad. sci. 1903, vol. 2, p.–16, are marked with an *.

FIDICINA
explanata, *–2 Brazil: vic. Rio de Janeiro.
MELAMPSALTA
radiator, 47–276 Japan.
MOGANNIA
histrionica, 2–283 China: Hong Kong.
ODOPOEA
cariboea, 36–169 San Domingo: near San Domingo, vic. Samana Bay.
domingensis, 36–172 San Domingo: near Samana Bay.
PAMISA
angulata, *–15 Brazil: Chapada.
protracta, *–13 Brazil: near Rio.
PLATYPEDIA, 29–23
areolata, 3–285 (Cicada) Wash.: E. of Ft. Colville.
minor, 29–81 S. Cal.
putnami, 17–455 (Cicada) Col.: vic. Clear Creek; Vt.: Ogden.
PLATYPLEURA
fenestrata, 2–282 Japan: Simoda.
PROARNA
squamigera, 45–56 St. Vincent.
valvata, 29–84 Tex.: vic. Pecos river; Ariz.: Camp Grant.
PRUNASIS
venosa, 29–82 M. and S. Tex.
TIBICEN
blaisdellii, 36–163 Cal.: vic. San Diego.
cruentifera, 36–161 Nev.: vic. Reno, vic. Webber Lake.
cupreosparsa, 30–43 Cal.: near Los Angeles.
hesperia, 16–342 Col.: vic. Denver city.

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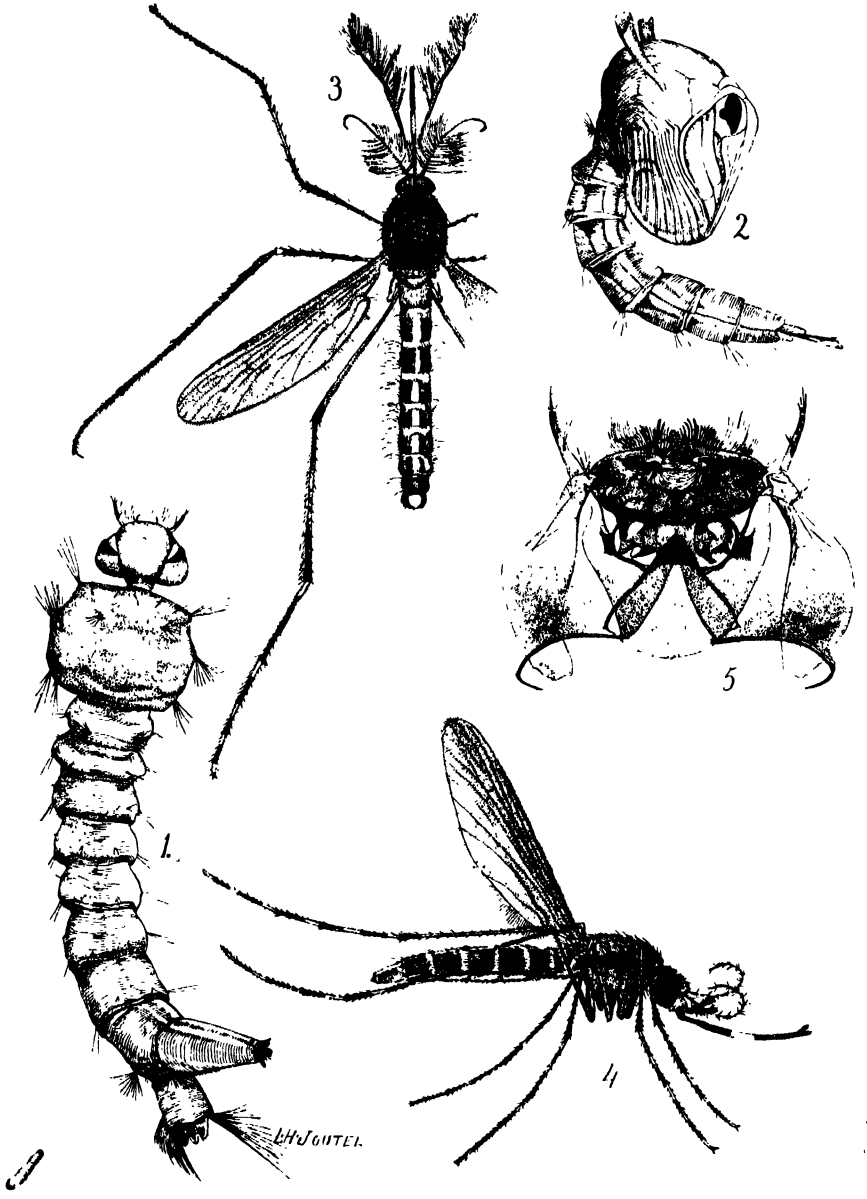

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